and ... **PASSION-BASED CO-CREATION**

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PASSION-BASED CO-CREATION

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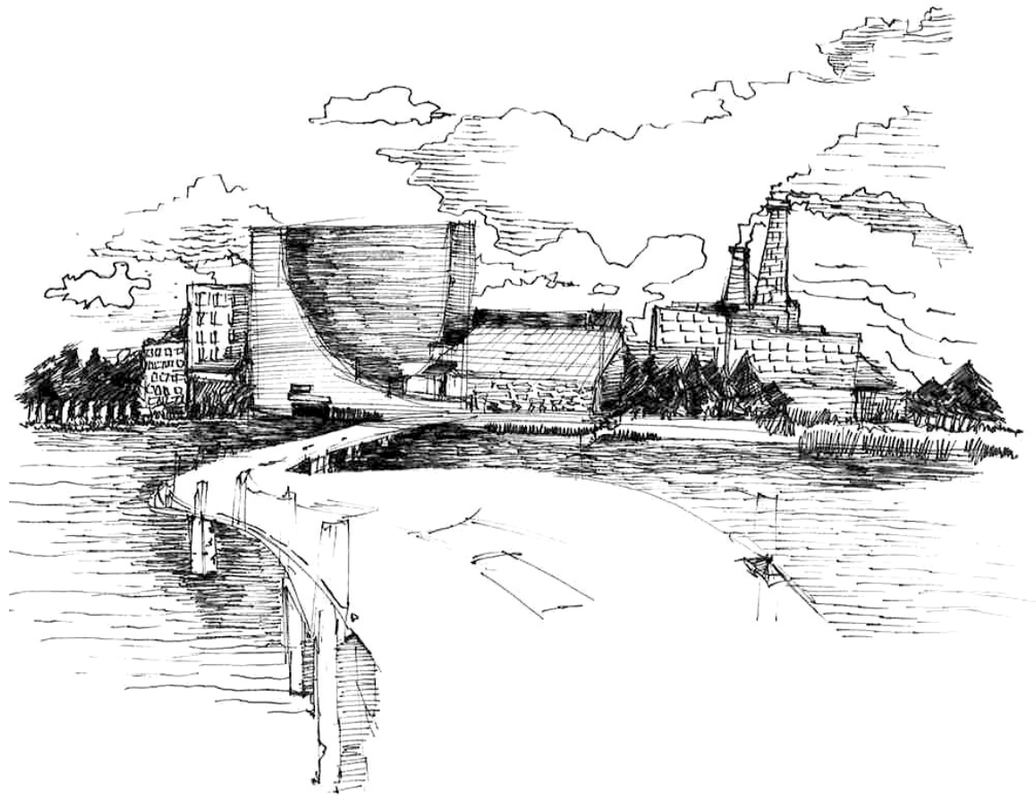
WHERE THE HECK IS OTANIEMI?

IF YOUR CURRENT APPROACHES ARE NOT WORKING AS WELL AS YOU WOULD LIKE THEM TO, IS THERE AN ALTERNATIVE?

Since October 2008, approximately 100 000 people have visited Aalto Design Factory (ADF) in Otaniemi. Where is this, one might ask, or even more importantly, why should one care? For now, let us just say that Otaniemi (located in the capital region of Finland, by the way) is the place of birth for the decade-long but still ongoing journey to create a better way of co-creating across disciplinary, professional, and geographical borders.

If you are reading this book, you probably already agree with us that innovation and development efforts are essential for survival, let alone success (on the off chance that you need a bit of reassurance, there are numerous studies on the crucial role that new products, services, and enterprises play in the economy[1]). While many recognize that the challenges that come along with modern, open, and complex problems require new approaches to development, it is less clear what these approaches are and what steps one should take. This uncertainty makes it easy to keep repeating existing tactics, even when they have proved ineffective. Design scholar Kees Dorst describes the mad persistence of First World War generals in ordering wave after wave of unsuccessful attacks on the enemy trenches, "because they just had no other strategy to break the stalemate."[2] If your current approaches are not working as well as you would like them to, is there an alternative?



This is a book about sparking and sustaining collaborative development activities driven by passion and intrinsic motivation. By development, we refer to any type of improvement activities and change initiatives, ranging from physical products, to services and to organizational practices. More specifically, this book is based on the Design Factory approach of supporting passion-based co-creation, which we believe is the key for successful development efforts that are sustainable in the long-term for both individuals and organizations. (While we will go on to more details, passion-based co-creation is, in a nutshell, a process of creating something together, sprinkled with a hefty dose of intrinsic motivation.) We discuss both the science behind the approach and the key methods and experiences involved in implementing and supporting such ways of working so as to design and drive change in organizations. The book will help in laying down the groundwork for taking a proactive stance to development.

Insights are firmly rooted in both science and personal experiences in the Design Factory Global Network

Drawing from the experiences of the global network of Design Factories

At present, the Design Factory Global Network is a family of twenty factories in twenty-two universities and one research institution, spread over five continents: Aalto University in Finland, CERN in Switzerland, Duoc UC in Chile, Escola Politécnica USP in Brazil, Ghent University in Belgium, Kyoto Institute of Technology in Japan, Pontificia Universidad Javeriana Bogotá and Cali in Colombia, the Middle Eastern Technical University in Turkey, the NHL University of Applied Sciences in the Netherlands, Pace University and Philadelphia University in the US, Politécnico do Porto in Portugal, Riga Technical University in Latvia, Universitat Politecnica de Valencia, Escola Superior d'Administració i Direcció d'Empreses (ESADE), Instituto Europeo di Design and Universidad Politécnica de Catalunya in Spain, Swinburne University of Technology in Australia, Tongji University in China, Waikato Institute of Technology in New Zealand, Warsaw University of Technology in Poland, and Yonsei University in South Korea. These platforms drive change in their home institutions towards a better learning culture and borderless collaboration.

In the beginning of 2010, a new university was formed in Finland, merging together the nation's three leading universities of technology, art and design, and economics. The new university, initially coined the "Innovation University" and eventually named Aalto University, brought together Helsinki University of Technology, Helsinki School of Economics, and the University of Art and Design Helsinki. The university merger, a first in the country in terms of scale and significance, has been seen as a flagship project in the larger scale development of the higher education and innovation systems in Finland[3], as well as the national-level holistic approach to innovation[4]. The aim of the merger was to open up new possibilities for strong multi-disciplinary education and research creating a "unique, integrated seedbed for innovation."[3]

Preceding the merger, a research and development project at the Helsinki University of Technology had explored working environments that would provide optimal support for interdisciplinary product development work—workshop formats, prototyping spaces, university–industry collaboration practices, how expert developers work ... The outcomes of the project were identified as possessing high potential during the preparation of the university merger. In 2008, the project was scaled up to become one of the spearhead projects and first physical manifestations of the new university as an open platform for integrative interdisciplinary education, research, and industrial collaboration. The platform was named Aalto Design Factory.

ADF has since become an established platform for passion-based interdisciplinary co-creation, created initially to confront some of the widely recognized shortfalls in engineering education and explore new forms of fruitful interaction between students, researchers, and professional practitioners. In practice, ADF and other Design Factories bring together stakeholders from inside and outside of universities and from different disciplines within an open collaboration environment geared towards fostering interaction, experimentation, chance encounters, and continuous development. Design Factories are not focused on specific disciplines of design but encompass the view of design as a general human action to solve problems, or changing existing conditions into preferred ones[5].

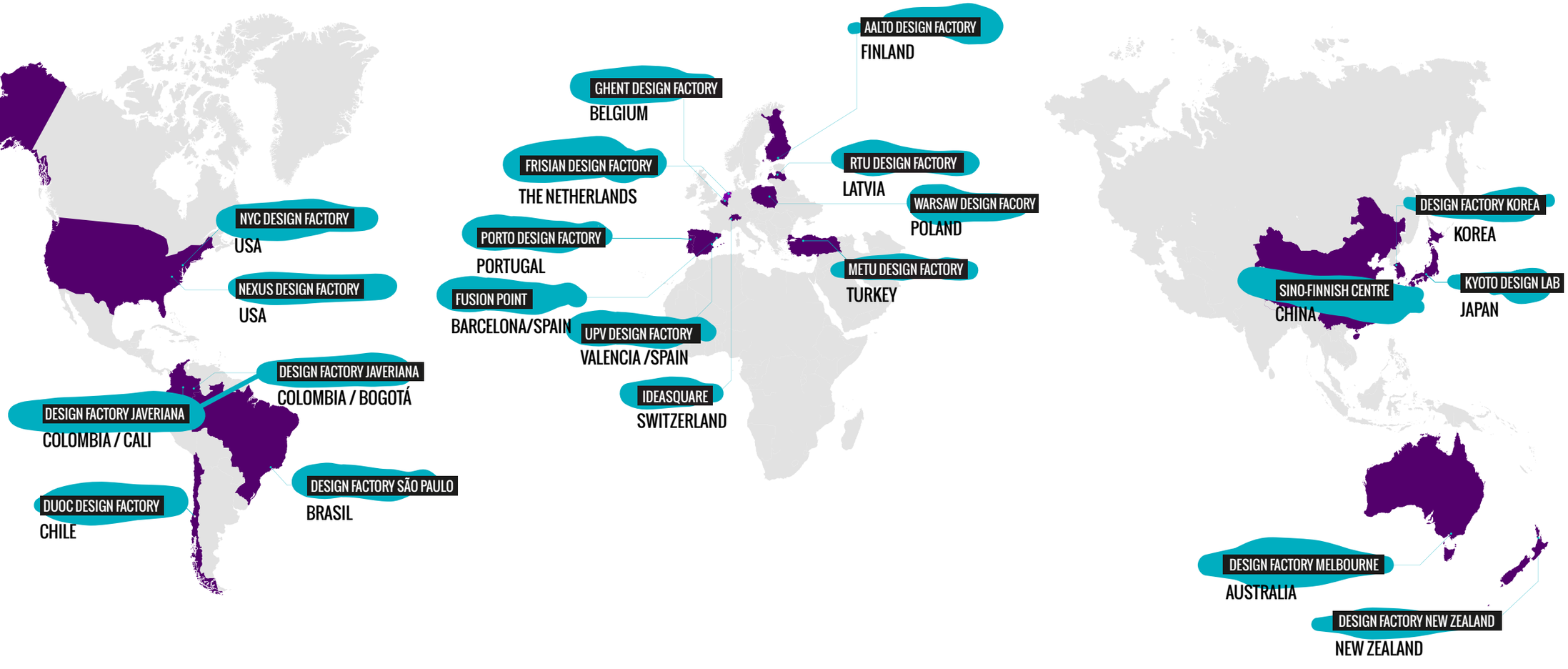
Design Factories are built to break disciplinary silos as well as hierarchical and organizational barriers. A student can bump into the CEOs of major corporations while getting her or his coffee, and be able to discuss her or his ideas with them informally and without restrictive hierarchical barriers. Physical proximity, serendipitous chance encounters, and knowledge sharing play a major role in Design Factories as do prototyping facilities that are available around-the-clock, including a continuum ranging from paper-and-tape modeling materials to electronics and machine shops. The facilities are designed for flexibility with students, staff, companies, and visitors alike being able to utilize a number of collaborative spaces, further emphasizing the low hierarchy and proactive climate of the Design Factories.

The concept has proven to be successful in both boosting existing collaboration and in sparking new initiatives. For example, in Finland, the ADF platform helped the founders to catalyze the birth of Aalto Entrepreneurship Society, an initiative that has had a national-level impact on the start-up culture in Finland[6], which has subsequently lead to, among other things, SLUSH, an internationally acknowledged ever-expanding mega-event in the start-up scene.

None of the Design Factories are exactly alike. Each Design Factory has its own organizational, cultural, and national contexts that have contributed towards, as well as imposed restrictions on, the strategic direction and goals of the local platforms. However, all of the factories are built on the same principles and values of open, passion-based, multidisciplinary co-creation. As a result, the network helps to establish trust between people from different institutions and lower the barrier to agile collaboration across diverse national cultures. We have never preached the adoption of specific processes, tools, or formalized methods, as to do so would certainly be a recipe for failure. Rather than copying or licensing a proven concept, the global network has aimed to create new, locally effective adaptations and iterations of

passion-based co-creation in order to ensure continuous collective learning and going beyond the initial concept. This is, in essence, what this book is—an attempt to share the principles we have found effective and illustrate the various adaptions that have worked for us.

The contributors to this book are people who have worked in different contexts of research and practice at various Design Factories. The insights they offer are firmly rooted in both science and personal experience. Viewing the phenomenon of passion-based co-creation through such multiple lenses offers a possibility to reflect on the multitude of relevant questions about supporting development work in diverse settings. Hopefully, these ideas act as a starting point for sparking and sustaining a culture of passion-based development in your own unique context.



PASSION BASED CO-CREATION

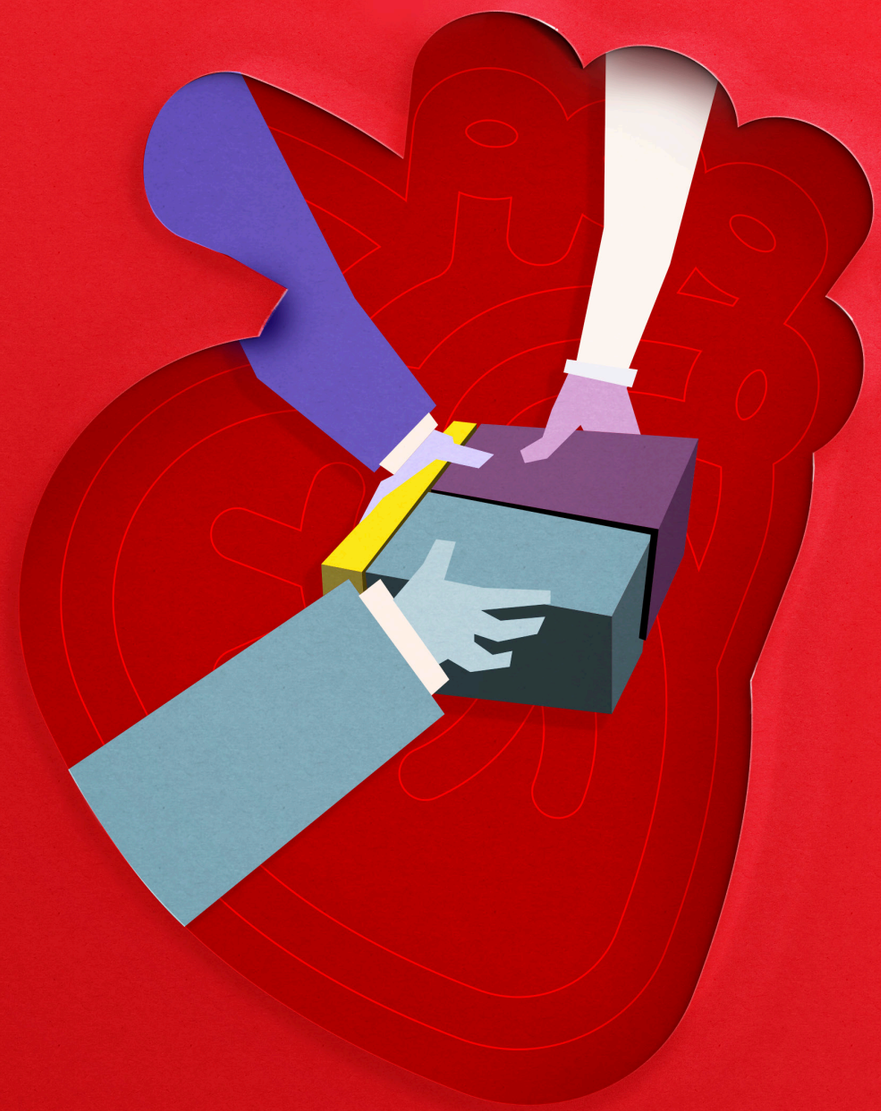
Moving beyond collaboration by

• gathering the three building blocks of passion

• building on a foundation of will and skill for collaboration

• experiencing and experimenting to create, and finally

• stir, empower, embrace, connect, and act in order to co-create



Setting the stage: From lonely riders to co-creators

As the world becomes increasingly interconnected, the problems that organizations face become more open and entwined. Modern knowledge work is frequently characterized by ill-defined, "wicked" problems[1]. These problems typically have no definite solutions that can be identified beforehand, and the success of the adopted approaches can only be assessed in retrospect[2]. At its simplest, the differences between structured and ill-defined problems can be observed in the difference between choosing a flavor of ice cream at a kiosk and creating one at home: While the first might be a daunting task if faced by a hundred options and unsure of one's preferences, in theory one might sample all the flavors and determine the "best fit." In contrast, when creating a new ice cream flavor, there is a seemingly unlimited pool of options (Watermelon? Zucchini? Seaweed? All of them?) and success criteria are unclear (Taste? The amount of mess made in the kitchen? How long it takes?). These basic uncertainties are exacerbated when moving on from making ice cream at home to attempting to alleviate climate change or making the next best-selling app. The current situation, the exact goal, and the possible means to inch toward the goal are all unclear and uncertain—how do you know what would be a good starting point? Or whether you are going in the right direction? Wicked problems are not only faced by professionals working in the fields of design—such as engineering and architecture—but in any innovation activities, whether dealing with products, services, processes, or society at large. These types of problems require the consideration of a multitude of issues, which often present contradictory requirements. This leads to the highly challenging but critical task of having to make problematic decisions about trade-offs between conflicting objectives while relying on insufficient information. Dealing with these types of problems is very much opposed to straightforward problem solving, such as mathematics or chess, where the results and the impact of decisions made can be logically deduced. Complex issues touch upon multiple domains instead of being neatly bound within a single discipline. Furthermore, the amount of information available has exploded, with new knowledge being created at an ever-increasing pace. While the myth of a lone inventor seems to persist even in the present day, there is increasing evidence on how connections and networks are in fact the key to innovations[3]. Present-day professionals need to be able to step out of their disciplinary silos and well-guarded territories in order to efficiently collaborate with people representing a multitude of perspectives, disciplines, and cultures. We need to adopt a holistic view to confront the complex challenges we are facing.

Getting everyone in on the game

Innovation and entrepreneurship have been brought front and center as means to address the growing complexities our societies face. Continuous development is called for in organizations in order to build and maintain success. You will be hard-pressed to find anyone opposed to development and improvement in principle. It may, however, be equally hard to find people who agree on how we might go about pursuing these goals. Even the terminology around creativity and innovation can be somewhat confusing, with various terms being used in an overlapping and contradictory way. What does one mean when talking about creativity? How about innovation? Ideas? Innovativeness? Creation? As these concepts are central to themes discussed in this book, it is worth taking a brief moment to clarify these concepts and what we mean by them. Ideas and inventions are the staring points that can be developed into innovations. An idea is a thought or suggestion as to a possible (new) course of action, whereas an invention is an idea with some sort of technological newness or leap included within it. In other words, all inventions include ideas, but not all ideas are inventions. Innovations, on the other hand, are the end-results of the process. They are ideas or inventions that have been successfully implemented. Typically definitions require innovations to have been successfully introduced to the market and to have been a repeated source of success. The road from initial ideas to innovations is long and anything but straightforward.

´´Pulling off a Leonardo da Vinci act alone will not work in the face of increased information and complexity``

There are many steps in the process where one can aim to make an improvement—enhancing initial ideas, improving idea development and advancement practices, or fine-tuning implementation. Trying to achieve these can be a puzzling task. Not only are the challenges that we are facing growing in complexity, but so are the arrangements to pursue them. Knowledge work is increasingly conducted in a changing setting by teams working in dispersed projects[4]. Remote working is on the rise, with nearly a fifth of the entire workforce reporting working at least occasionally from home in the US and Finland for example[5]. Further new forms of working—such as employee sharing, crowd employment and voucher-based work—are emerging[6]. There are already over 50 million freelancers of some sort in the US alone[7].

Working in these volatile and uncertain conditions, centrally anticipating and planning actions becomes unviable[8]. Even the best prepared plan will fall short sooner or later, requiring initiative to achieve success whether one is acting as a president or a call center agent[9]. As the chief of staff of the Prussian army, Helmuth K B G von Moltke, noted already in the 19th century: "No battle plan ever survives contact with the enemy." Proactive development efforts are required from the entire workforce in order to secure flexibility and competitive edge. Organizations far too often rely on a few star players. The dominant rhetoric has long focused on individuals that both generate ideas and push them towards realization, instead of understanding the collective as the ulti-

mate source of new ideas. While individual heroic champions[10] may push through an idea or two, even in the face of opposition, no one can go against the grain indefinitely. Sooner or later these top performers will tire of the friction and quit their efforts or change organizations.

By definition, "above average" workers are a minority, a commodity that not all organizations can access and even less employ exclusively. Most of us must make do with the average worker. However, this does not necessarily mean that we are worse off. Many examples of so-called average teams outperforming a collection of top players can be found in business and sports alike. In order to harness this potential and to capitalize on the diversity found in organizations, creating and advancing new ideas should be made not only possible but easy for the vast majority of workers. Embracing the power of the average worker not only builds a more sustainable base for development (by relying less on any one individual), it can also attract the much-coveted top players to join and stay in the organization. Further, with new generations demanding self-fulfillment in their work[11], effective and efficient processes for co-creation can provide the meaning they are looking for while benefiting the bottom line.

Count on average workers rather than rare stars to create and advance new ideas

From method madness to ingrained habits

All too often it seems that organizations respond to the need to boost creative output on a more continuous basis by introducing various idea generation methods and techniques. While there is nothing wrong with idea generation methods, ideation sessions are only a small piece of the puzzle of developing eventual innovation output.

Since Alex Osborn introduced brainstorming in 1963[12], the production and promotion of new ideation methods by academics and consultants has been much faster than research on their effectiveness. That said, the effectiveness of brainstorming itself has actually received quite a bit of research attention, with less than flattering results: group brainstorming has repeatedly been found to be more inefficient, both in terms of the quantity and quality of ideas, when compared to a similar sized group of people ideating individually[13]. This may not come as a surprise as the majority of us who have taken part in a brainstorming session have experienced the lack of anything that would resemble a "storm."

In all honesty, how often have you generated a mind-blowing idea during a brainstorming session?

Providing further evidence on the supposed inefficiency of structured ideation, a 1993 study of 106 companies[14] indicated that a mere one percent of useful ideas originated in specific creativity sessions. Among many other activities, boring meetings were deemed significantly more productive, accounting for about five percent of the ideas. Overall, only 24 percent of ideas were reported to surface during actual work, while the majority manifested outside of work, while travelling, commuting, strolling in nature, doing sports, and so forth. In line with this, in a study of 600 business travelers by Vanson Bourne for Hewlett-Packard[15], 56 percent of the respondents reported getting their best ideas when outside of the office. While these studies have not been conducted with scientific rigor, they are indicative of the general tendency of ideas often surfacing outside any specifically intended moments.

If brainstorming is so inefficient and the role of creativity methods in producing ideas is so insignificant, why are organizations—such as IDEO (a highly prominent design agency[16])—still promoting it so forcefully as part of their version of design thinking[17]? And if it works at those organizations, why do studies often indicate that designers do not rely on brainstorming or other structured methods for producing ideas? Should we rely on methods in producing creative outputs at all?

Several reasons for the ineffectiveness of group ideation have been identified in laboratory studies, such as social inhibitions (e.g., anxiety, loafing, free-riding) and cognitive interference (e.g., production blocking, cognitive load, task-irrelevant behavior[18]). While these hold true, research conducted in context, rather than on fictional tasks in laboratory settings, has shown that group ideation has advantages above and beyond the actual ideas produced at that precise point in time[19]. These benefits include building motivation and commitment as well as the efficient dissemination of knowledge.

Our studies in design agencies suggest that routinely undertaking ideation seems to have made it into a skill within organizations, leading to the sessions being more productive. On the other hand, designers can become so accustomed to "getting into the generative mode" in which ad-hoc ideation can be more important than any kind of organized sessions and become woven into the very fabric of work in those organizations. Rather than relying on structured methods of specifically organized ideation sessions, many designers seem to mainly engage in ad-hoc ideation next to their work stations and, for example, on coffee and cigarette breaks[20], as depicted in this somewhat typical comment from a designer:

"The method I use [to generate ideas] is going out for a cigarette. That's where the problem crystallizes and the solution appears. If I bump into any of the other smokers on the way, I ask for them to join me."

These moments are often triggered by external representations of the problem at hand such as sketches, drawings, or physical models. Producing something visual or tangible often gets other designers interested and spontaneously involved in discussion, reflection, and ideation. The reality presented by many studies of design in practice stands in stark contrast to the extensive amount of structured methods and tools intended to facilitate creativity.

There is a definite appeal to methods and straightforward, easily communicated approaches that come with a promise of ensuring novel and useful ideas. While for an ideation session, the accumulated evidence seems to suggest that any decent method properly applied is likely to be better than no method at all[21], a single method or even mastering a host of creativity methods are far from being enough to ensure creative outcomes, specifically in a complex social or organizational setting. It is evident that the methods are not going to be the miracle cure but they do have their place in the big picture.

A more holistic approach is needed to drive attempts to realize the innovative potential of organizations. This is what we have aimed to achieve with our take on co-creation in the Design Factories across the globe—find core considerations to take into account in local adaptations of promoting development efforts. While solutions may differ dramatically on the surface level, they often address similar root issues that we have noticed in both theory and practice.

TOWARDS PASSION-BASED CO-CREATION

Key points

- Defining passion-based co-creation as intrinsically-driven collaborative development action resulting in a new creation - whether it's tangible like a product or draft, or intangible like a service or process
- Passion-based co-creation is not discipline-specific - anyone can use it, and typically several different types of stakeholders are involved
- Think of passion-based co-creation as the user interface for diverse expertise

Maintaining constant levels of proactive innovativeness in volatile, dispersed environments is a daunting task that no single method could claim to solve. Alas, we too have to admit our inability provide a satisfying answer. However, based on our experiences in the diverse Design Factory network community, we have come to see that reflecting on some key questions seems to be fruitful regardless of institutional context. How do we inspire people to engage in development efforts? To persist on the long path of turning ideas into reality? To benefit from others' expertise in doing so? In seeking answers to these questions, we have come to embrace a holistic development approach that we call passion-based co-creation. Rather than being a method, or even a set of specific methods, it reflects a collection of overall principles and ways of working regarding how one can go about creating a sustainable basis for improvement and creative work.

How do we inspire people to engage in development efforts? To persist in the long path of turning ideas into reality? To benefit from others expertise in doing so?

Simply put, co-creation is the process of creating something together[1]. In our view, co-creation could be described as having three basic elements: collaboration, development action, and the resulting creation. Formal cooperation or coordination is not sufficient. Rather, all of the involved stakeholders are active contributors. Stakeholders are perceived as equal, in contrast to the asymmetrical settings in many well-established collaborative development approaches. For example, while user-centered design and employee involvement programs encourage involving users or employees, they are still clearly designer- or manager-driven. Co-creation aims for working together towards a mutually desired goal on more equal terms.

The change-promoting nature of co-creation is reflected in its etymological roots. The etymology of cooperation points to the Latin words con operari, operating together (without the specification of form or target), and collaboration points to con laboro, which has a more concrete tone[2] but still lacks a reference to what results from this activity. Co-creation further concretizes the output of the process into a new creation. It builds on collaboration, taking it a bit further: While collaboration may result in a shared meaning[3] rather than a more tangible output, co-creation by definition results in a shared creation, whether it is a material object or something immaterial such as a service, a musical piece, or a new process.

This essential activity of creation is in many contexts referred to as designing, and indeed, the foundations of this book have been laid in places called Design Factories. While the activity and people immersed in it are typically simply referred to as design and designers, holding a general notion about a designer or design as a discipline might not be justified. It is evident that design as both a discipline and profession is not uniform but rather denotes a wide variety of design fields and domains. Furthermore, the activities that could be encompassed under the umbrella of design are in flux[4] and constantly expanding. This is seen in the surfacing of new distinctively named design disciplines. The numerous disciplines of design include fields as varied as mechanical engineering design, software design, architectural design, urban planning, industrial design, furniture design, graphic design, textile design, and service design, to name

but a few. Our approach is not specific to any discipline of design but draws from and is applicable to various fields and their intersections. We share the bias for action ethos of the Stanford d.school variant of design thinking[5].

Co-creation often includes several different types of stakeholders, taking advantage of their wide array of perspectives and areas of expertise. This can manifest, for example, in utilizing multidisciplinary development teams and conducting parts of the development process together with customers and end-users. Co-creation as a concept highlights the dynamic nature of development interaction and is often marked by its informal nature. In addition, co-creation emphasizes acting over planning, being an iterative, hands-on approach to development. Experimentation and the abundance of prototyping and visualizations can be seen as distinctive and essential features of co-creation. In practice, it is important to provide a wide variety of materials for prototyping and illustration since while professional designers can easily illustrate their ideas with pen and paper, other stakeholders often need other kinds of materials in order to be able to do the same.

EXPERTISE
VALUE

=

HARD x (soft)²

Approaching the innovation process from the perspective of the skills needed in co-creation, rather than development process skills in general, provides the benefit of being able to specify the required behaviors and practices in more detail. Co-creation operationalizes the challenge at hand into a more manageable set of questions to address. In addition to domain-specific "hard" skills (such as skills in computer science, bio-technology, psychology, industrial design, or mechanical engineering), successful development requires a bunch of "soft" skills.

We think of these skills as the interface to domain skills: Even the best processor can be next to useless without a working interface. Indeed, studies have shown that grit, for example, is one of the most significant predictors of success, over and beyond intelligence[6]. Passion for development cannot be considered as the luxury of a few. We need to build an environment and community that nurtures that passion and continuous development, weaving development efforts into the fabric of work. In what follows, we aim to identify key considerations when motivating for development and collaboration, and provide insights on how these might be supported in practice.

THE THREE BUILDING BLOCKS OF PASSION FOR DEVELOPMENT

Key points

- External "if-then" rewards and punishments can be detrimental for creativity
- Support the innate needs of competence, autonomy, & relatedness
- Intrinsic motivation through
  - meaningful goals tied to their context,
  - perceived possibilities to reach the goal (efficacy & support), and
  - noting progress towards the goal (feedback, iterations, & small wins).

The first issue to tackle when supporting co-creating is getting people motivated to put in the required effort. The aim is to create an environment that makes wanting to co-create as easy as possible. In general, motivation is a key consideration in supporting any development efforts as creating something new requires more than mere compliance. The connection between motivation and creativity is a widely recognized one[7]. Creating and implementing change requires initiating and sustaining proactive, self-started development actions—following mere orders will rarely do the job in co-creation efforts.

One of the pioneers in the study of human motivation, Frederick Herzberg, noted that external motivators cause only movement, not true motivation[8]. Development motivation cannot be secured by using only rewards and sanctions—in fact, extrinsic rewards tend to diminish intrinsic motivation[9] and can narrow foci[10], creating "tunnel vision" and functional fixedness[11], impairing creative performance. Especially "if-then" types of rewards have been found to have a negative impact on performance[11,12]. While this does not mean one should ignore external rewards, it serves well to acknowledge that they will go only so far—they are what Hertzberg labeled as "hygiene factors": A lack of external rewards, such as compensation and job security, might deter motivation, but their presence will not secure it[8].

Actual motivators are the softer but more potent stuff: experiencing one's self as skilled, having control over one's goals and methods, and being connected with others[13]. These are the factors that have been found to enhance productivity, conceptual understanding, and persistency, to name a few examples[13]. They act to fuel the intrinsically motivated behavior stemming from the self, motivated by the innate needs of competence, autonomy, and relatedness[13]. Several models have been suggested for intrinsic motivation, including components such as experiencing self-determination and competence[14], experienced meaningfulness, responsibility for outcomes, and knowledge of the actual results of the work[15] or a having a sense of impact, competence, meaningfulness, and choice[16]. The recurring themes are the perceived importance of the goal, perceived capability to reach the goal, and perceived progress towards the goal. In order to sustain development effort, all of these three bases need to be covered.

> "Intrinsic motivation has been found to enhance productivity, conceptual understanding, and persistency."

Luckily, many forms of support have a positive effect on more than just one of the building blocks of motivation. For example, support, communication, and providing a context for tasks so that the impact and relevance of actions is clear not only helps to see the importance of the goal but can also make the goal seem easier to attain. Perceived capability to reach the goal relies on experiencing one's self as capable and as being able to influence the situation. Activity-specific self-confidence, or self-efficacy[17], reflects the expectancy that one can perform a certain action effectively and is crucial for encouraging the persistency that is needed to make development efforts bear fruit. The father of the concept, Albert Bandura, originally suggested that self-efficacy was increased via repeated performance success, vicarious (second-hand) experience, and encouragement[17]. Thus co-worker trust[18] and workplace communication[19], and the access they provide to

encouragement and experience, not only affirm the importance of the goal but also make the goal more feasible by enhancing self-efficacy.

Of course, you need to balance responsibilities with resources in order to act on them. Autonomy is one of the key components for intrinsic motivation as it has a triple-effect on intrinsic motivation. It is one of the innate needs reported by Ryan and Deci, directly increasing intrinsic motivation[13]. It also promotes self-efficacy[18,20], for example, job enrichment (the vertical expansion of work, i.e., increasing the opportunity and responsibility to make decisions) has been shown to be particularly effective[19]. Autonomy increases perceived capability to influence the situation. It provides employees with more opportunities to acquire new skills and responsibilities[19], and may make employees ´more receptive to change and feel less threatened by it[21]. Perceived control over the situation, in turn, is tied to demonstrating that efforts are bearing fruit, the third common denominator of motivation theories.

Progress may, in fact, be the single most important motivational factor supporting long-term development efforts. Taking the initiative is not enough; efforts need to be renewed throughout the development cycle, meaning that one needs to find the motivation to develop something over and over again. Indeed, based on a study of 12 000 diary entries, Teresa Amabile and Steven Kramer found that day-to-day motivation in creative work largely hinges on perceptions of progress[22]. Here, iterative experimentation can offer huge benefits. In design, different types of prototypes and representations in which developers conceive, describe, and communicate ideas are a significant part of the experimentation process[23], enabling "reflecting in action[24]." The literature on design thinking unanimously highlights the importance of an experimental approach, not only in design but in development in general, with early and continuous prototyping being necessary and beneficial throughout the entire process[25]. Prototypes are seen as tools for thinking and communication[26] that can concretize the state of the process, thus making it easier to spot progress.

Progress may be the single most important motivational factor in long-term development efforts.

Experimentation is also compatible with adopting a strategy of producing small wins in which people "identify a series of controllable opportunities of modest size that produce visible results[27]." Producing small wins promote commitment[28], attracts allies, deters opponents, and lowers resistance to subsequent proposals[28]. They scale down what is at stake and mark progress[29], offering immediacy, tangibility, and controllability[28], and providing meaning, perceptions of control, and manageable-sized challenges[28]. As a result, small wins can increase self-efficacy[30], confidence[27], and learning[31]. Experiments that produce small wins can increase all of the three cornerstones of intrinsic motivation, clarifying the goal at hand and reassuring one of both capability and progress. Together, small wins, iterative experiments, autonomy, and support form the cornerstones for sparking and sustaining a passion for development.

CREATING A SHARED WILL AND LANGUAGE FOR CO-CREATION

Key points

- Welcoming the potential of people
- Nurturing trust through:
  - finding common ground and goals, and
  - providing freedom and respect.
- Facilitating communication through:
  - an open environment with low hierarchy,
  - prototyping and experimentation, and
  - physical proximity.

Evoking the passion of people towards developing something is only one half of the co-creation approach. Co-creation cannot, by definition, happen in isolation. In addition to motivation towards the task, co-creation requires the motivation to collaborate with others in order to achieve the goal. We strongly believe that you cannot actually talk about departments, disciplines, or organizations collaborating—it always comes down to people working with people. In order to collaborate effectively, these people need to be open and respectful towards each other. We need to realize the potential value that different perspectives can add to our own thinking and efforts.

At the end of the day, it's people—not organizations—that work together.

In creating a shared will to co-create, *building trust is* one of the most important antecedents. It is a basic prerequisite for successful teamwork and development and has been correlated with a multitude of positive effects, such as increasing knowledge sharing[32], commitment[33], innovativeness[34], and the willingness to take risks[35]. Trust, mutual respect, and being comfortable with participating in a group form the basis for experiencing psychological safety, an aspect that can make or break innovations in organizations[36]. Without a feeling of psychological safety, people will not dare to present their ideas and express their opinions freely. While for most people this is intuitive and easy to recognize when reflecting on personal experiences, organizations still typically fail to pay enough attention to the issue. In the words of Peter Sheahan, the CEO of ChangeLabs: "The secret killer of innovation is shame." The very basic groundwork for establishing trust lies in perceived goal congruity, or the belief that both parties are working towards shared or complementary goals[37].

Sometimes building trust in co-creation might be a bit trickier than within traditional silos. Bringing in different people from different backgrounds and different perspectives means that we are not necessarily working with people "like us" or on our "own territory." This is an absolute benefit but can also create many misunderstandings. Dealing with these requires a solid foundation of trust and respect. We do our very best to be open and welcome people,

Mutual respect lays the foundation for dealing with the inevitable conflicts that arise from different people working together

assuming that a person has something valuable to contribute regardless of their position or background.

One way of communicating trust and respect is *by lowering hierarchical barriers*. We avoid using titles and call people by their first names, whether a student or a CEO. On any given day, you might find the manager emptying the dishwasher or sweeping the floor. While Finland, the birthplace of the first Design Factory, is a country with relatively small power distances and high levels of trust, creating an open microclimate that clearly communicates that things are done a bit differently at a Design Factory has been at least as important (if not more!) in the Design Factories of other countries, such as China and Chile. Organic organizational structures, marked by low levels of hierarchy and bureaucracy, have been found to increase successful collaboration by being more conductive for interdepartmental

communication and learning[38]. Having a clear understanding of the role and skills of different contributors makes the co-creation process more efficient, minimizing unnecessary overlapping and increasing help seeking[39].

Another way that people can be encouraged to work together is through increasing identification with the joint efforts. A *shared identity* can be built on perceived respect[40] and developing shared goals[41], particularly when the different stakeholders are given true control over the shared result[42]. A shared identity amongst different contributors[43] increases willingness to voluntarily contribute to the group[44], and is connected to a range of positive organizational outcomes[45]. Thus valued goals and autonomy enhance both individuals' intrinsic motivation towards development and their willingness to work together in order to achieve the goal. Additionally, the iterative, experimental approach inherent to co-creation can lower the threshold for participating in collaborative development efforts by scaling down the required input and decreasing the level of risk associated with taking part[46].

Once a shared will has been established, the integration of efforts is still needed for working efficiently towards a successful end result. Shared means may be even more important than shared goals in actual collaboration[47]. The importance of a forming a holistic view of the problem and solution is highlighted in design thinking literature[48], and understanding the context of the problem can enable better prioritization of efforts. Having a holistic view of the process also plays a significant role in enabling co-creation as it supports better coordination amongst the stakeholders. Indeed, neither a shared will nor successful coordination can be achieved without *effective and efficient communication.*

However, the wide variety of stakeholders involved in development efforts can pose a challenge for effective communication, as each group tends to have their own professional jargon and assign different meanings to concepts. *Physical objects* can help to bridge the boundaries between different stakeholders[49], helping to prevent miscommunication[50] and decreasing the amount of effort required to discuss and share ideas[51]. Experimentation and prototyping support providing rapid feedback and enhance learning, clarifying both the problem and the proposed solution[52]. Prototypes and visualizations have a definitive role as tools for both thinking and communication[53] in co-creation.

On the other hand, *being physically present* can make a huge difference in both the amount and quality of communication. All forms of communication decrease dramatically as the physical distance between people increases[39]. While constant co-location can be unrealistic in modern distributed and remote teams, it is worth considering at what points or phases are the investment in face-to-face interaction most required. For example, idea advancement efforts often hinge on communication and inclusion strategies that are more effective in person[54]. Many communicational barriers of cross-functional teams can be reduced by working in a shared physical space[55].

THE OVERALL PROCESS OF PASSION-BASED CO-CREATION

Seeing and feeling are needed to spark change

Stir: inspire; mix things up
Empower: communicate freedom and responsibility
Embrace: welcome all people and ideas
Connect: build bridges and work together
Act: concretize and do something

We have found experiential experimenting[56] to be descriptive of the co-creative approach to development efforts. Action-centric, iterative development, with first-hand experience of the topic and with the stakeholders, forms the basis for initiating and sustaining intrinsically motivated development efforts. Co-creation as a concept highlights the dynamic nature of development interaction, and is often marked by its informal nature. The Design Factory approach and values of passion-based co-creation can be explicated in five steps. We do not wish to promote a process-based turnkey solution, as packaging these types of approach to a simple process format is often problematic and leads to oversimplifying and dilution of the ideas, as may have been the case with design thinking[57]. However, in our experience, these overall steps can act as a checklist to ask the right questions when aiming to support the building blocks and antecedents of co-creation mentioned above. In the remainder of the book we discuss particular approaches associated with these steps.

I STIR

In order to create a will for change, things typically need to be mixed up from business as usual in order to spark some kind of a reaction. Show rather than tell what or how something could be done differently in order to fuel inspiration. Help people find something they are passionate about, something that resonates within. Development will is stirred up through enhancing the perceived importance of the goal by connecting it to meaningful, tangible implications.

II EMPOWER

In order to move from recognizing a need for change and sparking motivation onto initiating efforts, freedom and responsibility should be shared with all stakeholders. Proactivity is enhanced through positive perceptions of ability and support. While negative restrictions can increase setting change goals, perceived support and mandate have an impact on actually striving towards goals..

III EMBRACE

As a basic attitude, all people and ideas should be welcomed. Development efforts cannot be left in the hands of a few chosen, dedicated individuals. Rather, the entire workforce needs to be engaged and proactive in the current uncertain, volatile environment. In the mindset of supporting rather than choosing amongst people, projects, and ideas, ideas are not killed prematurely. A positive, inclusive, and trusting atmosphere helps to foster both individual development efforts and collaboration.

IV CONNECT

The complex, ill-defined problems that development efforts target require the experience and skills of a wide variety of professionals and stakeholders. Organizations need to build bridges between these different groups and support various forms of collaboration.

V ACT

Finally, once the stage has been set, one needs to act. Ideas need to be concretized, prototyped, and iteratively experimented with. Action is emphasized over planning—it is usually better to ask for forgiveness than permission. Experimenting helps to clarify ideas and gain feedback from other stakeholders and the environment, creating a learning process that hones initial raw ideas towards implemented changes.

While these five steps capture the overall approach in co-creation, we next dive deeper into how experiential experimentation can be organized and supported. As there are no one-size-fits-all solutions to innovativeness, we concentrate on key issues to be aware of, as well as offer some practical examples as a source of inspiration and as starting points for adapting co-creation to your own context. First, we take a closer look at the role of concretization activities, prototyping, and visualizations in enhancing communication and motivation in development efforts. Then we explore effective work practices on a team level, focusing on how to make the most of different backgrounds, skills, expectations, and even time zones. This leads up to the question of how we can create facilities and cultures that support such practices and efforts. We explore how physical and virtual collaboration environments can be designed to support co-creation. We look at key components of organizational culture, and how coaches and change agents can improve culture. Taken together, these sections of the book should give you a clear picture of what to take into account when developing your work and organization. While we provide plenty of examples of the answers we have come up with at various Design Factories in order to provide inspiration for how one might go about fostering passion-based co-creation, our way is only one amongst a multitude of alternatives. Hence, we invite you to use the insights of the book freely—in accordance with your specific needs and situation. In the spirit of co-creation, you may experiment with the contents, mix and combine them in different ways and, as you proceed, let your experiences inform and educate you towards your personalized approach to passion-based co-creation.

MAKING IT TANGIBLE

Making it tangible

Co-creation cannot be separated from experimentation. Prototyping is one of the key threads running through all activities in Design Factories—they are the tangible and intangible artifacts of experimentation. For many students, teachers, and practitioners, these concretizations are the entry point to Design Factory platform, whether they are utilizing the prototyping facilities offered at Design Factories to give form to their ideas or taking part in the various experimentation activities organized at the platform. The years have shown that pretty much anything can be prototyped, big or small, tangible or non-tangible, simple or complex. We have seen successful prototyping of things such as microscopic viruses, intangible university policies, gigantic buildings and heavy machinery.

At heart, prototypes bring development ideas one step closer to reality. In the process, they help to move thoughts and people. Prototypes can range from simple sketches to functional beta versions of products. For example, one of the research groups that have used Aalto Design Factory as a home base distinguishes between four categories of concretizations used in experimentation[1]: 1D Verbalization (such as written scenarios or personas), 2D Visualization (such as storyboards or customer journeys), 3D Forming and Modeling (such as the prototypes shown below), and 4D Action Prototyping (adding the dimension of time by, for example, trying out a new service sequence). These different kinds of concretization serve different phases and needs of the development process, but all have the ability to nudge both thinking and doing further along. While central in all experimentation, concretizations are absolutely crucial for successful interaction in co-creation, where people from different backgrounds, professions, and cultures attempt to create something together.

This section provides a glimpse of the multitude of concretization methods and forms available, focusing on the underlying benefits they offer in co-creation. First, Stefania Passera from Aalto University discusses the power of visualizations in aiding the affective, cognitive, and collaboration processes required in successful co-creation. She draws from both her research on visualizations and her experience as a teacher of a Finnish-Spanish interdisciplinary project-based innovation course called I2P[2]. Proceeding from 2D visualizations to 3D prototypes, Anita Kocsis and her Design Factory Melbourne colleagues take a look on the wider impact of these concretizations in facilitating co-creation by creating shared meaning and enhancing learning in diverse projects. They present examples from the interaction between various stakeholders collaborating in an Australian museum project as well as Design Factory student projects with industry partners. Finally, user innovation researchers Samuli Mäkinen, Pia Hannukainen and Sampsa Hyysalo from Aalto University demonstrate two low-cost techniques in order to explicate the perspectives of different stakeholders by making them tangible through collaborative physical modeling and user innovation toolkits. Their examples come from service design thus illustrating that making an idea tangible is just as valuable whether one is working with physical products, services, or processes. All the aforementioned stand to gain significant benefits from even very simple concretization activities.

As a whole, the three chapters in this section help to explain why making one's ideas tangible is one of the cornerstones of successful co-creation activities.

Various levels of prototypes

PD6: The product development process squeezed into six hours

One of the typical prototyping activities conducted at Aalto Design Factory is the PD6 workshop.[3] Many interdisciplinary project-based courses begin with a PD6 workshop, for example the nine-month PDP (Product Development Project) course[4] gathers both students and company representatives (who provide industry briefs) to work together for a day. PD6 has also been successfully utilized to kick-start new and stalling professional product design projects. Used in the beginning of the co-creation process, intensive low-fidelity prototyping sessions such as PD6 carry several benefits in facilitating future communication within the design team and stakeholders:

- **Familiarizing**
  stakeholders with each other, lowering the threshold for future contact and collaboration
- **Establishing**
  a common language and explicating requirements and knowledge related to the design target
- **Accelerating**
  and facilitating the team formation process by delivering shared initial experiences

PD6 workshop

All you need for organizing a PD6 are some crafts materials for creating low-fidelity prototypes (building blocks, play-dough, cardboard, straws, fabric … anything and everything will do), a design brief or problem statement, participants, and a facilitator (or a few) to introduce and keep track of the schedule.

An example timeline of a PD6 workshop

13.00–13.15
An introduction of the larger context of the day (strategy, course, or similar)

13.15–13.30
An introduction of the reason for the PD6 workshop, its basic idea and schedule, including some examples of low-fidelity prototyping to stimulate work. Requirements are also placed for reaching out to initiate the process of gathering relevant knowledge, for example phone calls to be made to experts to gain information and talking to possible users.

13.30–13.40
The division of participants into mixed teams of 4–6 people

13.40–13.50
The specific design brief for the day is given (e.g., design compact emergency shelters for flooded areas)

13.50–14.00
The provision of prototyping toolboxes and spaces for each team to work in

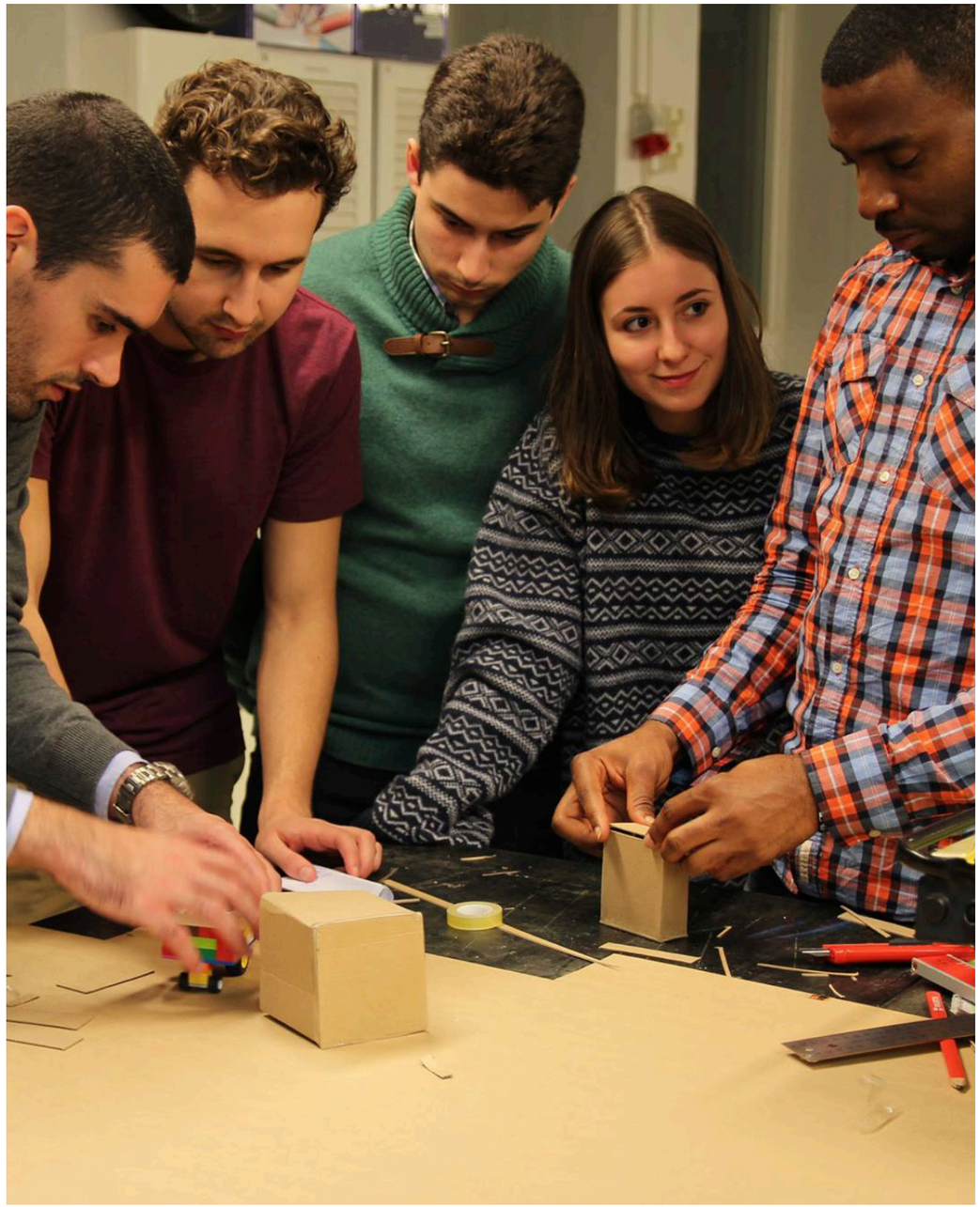
14.00–15.00
The teams work on the design briefs; the facilitator goes around and encourages prototyping

15.00–16.00
The facilitator has a 10-minute checkpoint meeting with all teams separately where the teams present their current ideas and prototypes: The facilitator announces a new requirement in the design brief, reflecting the inevitable surprises that will come along in creative projects

16.00–17.15
The teams work on the design briefs; the facilitator goes around and encourages prototyping (at 16.45 the facilitator gives the instructions for the final presentation)

17.15–18.15
End-result presentations from each team (e.g., a 5-minute presentation and 5 minutes for discussion and for teams to give marks for the utility, innovativeness, and feasibility of each presentation)

18.15–19.00
A feedback round for all of the teams, tallying team and facilitator points for each team and rewarding the highest score (e.g., with lottery tickets or some other small, insignificant token)



SHOW DON'T TELL

Conceptualizing and sharing abstract knowledge

Stefania Passera

Key points

- Visualizations in co-creation are not about artistic skill, but rather concretizing tacit information.
- Affective visualizations aid empathy
- Cognitive visualizations aid thinking, understanding, and analyzing
- Collaborative visualizations aid coordinating work, ideas, and goals

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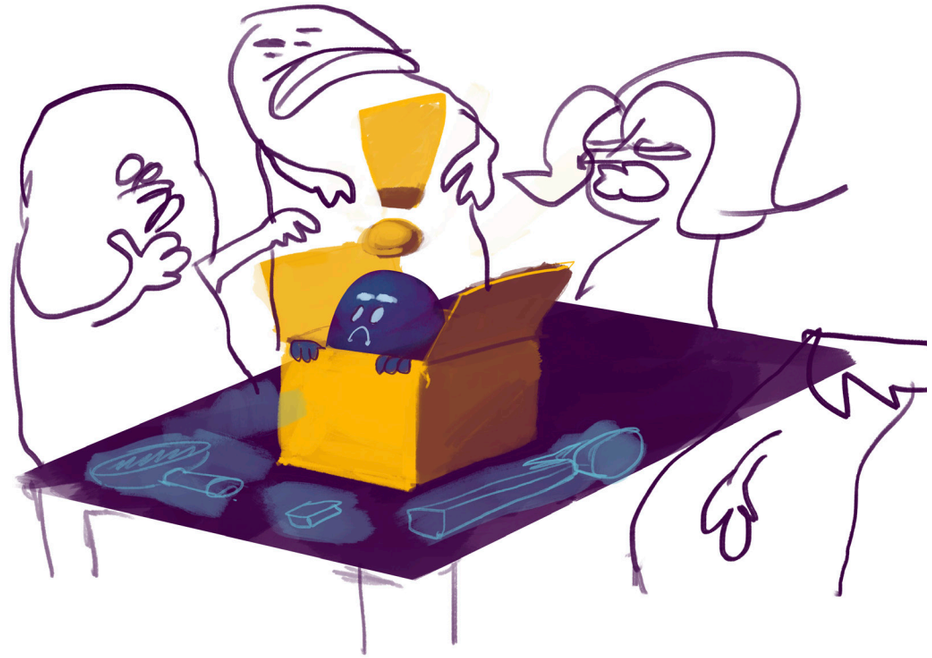
Sometimes textual and verbal communication is not enough in order to convey complex ideas and share knowledge. This is especially true when we try to communicate fuzzy and half-formed ideas, externalize personal insights, or explain any complex topic in which we need our audience to have an understanding at both overview and detail levels.

These situations probably sound familiar to those of you working in teams engaged in creative, innovative projects. How do I summarize and powerfully deliver what I discovered in my field study with users? How do I communicate the idea for a new service to my teammates and then to the customer? How do I get all the stakeholders of a project on the same page and get them to commit to deadlines? So often, we feel the difficulty of expressing our grand vision and the logic, or evidence, behind it. As Von Hippel puts it, information is "sticky" and is not easily transferred to others[1].

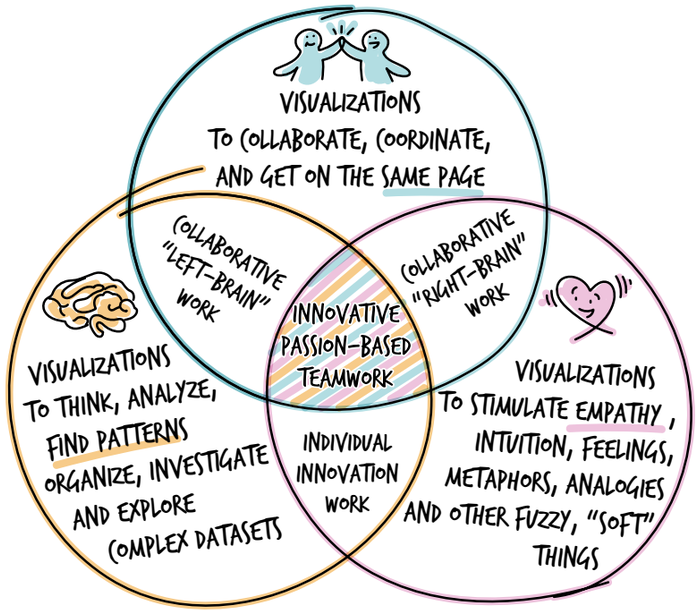
How do we bridge these communication gaps? One way forward is to express it visually and put everyone on the same page. Humans are visual creatures as vision is the most powerful and developed of our senses. For comparison, while our sight captures 10 MB of sensory data per second, our touch provides us with just one megabyte, from our noses and ears we receive only 100 000 bits of data each, and from our tongue a mere 1000 bits[2]. The old adage "one picture is worth thousand words" often stands quite true as we are naturally rather talented at making sense of visual information, finding patterns, understanding visual metaphors, and producing and reading symbolic and diagrammatic representations.



Knowledge can be tacit (embedded in practices and personal experiences; hard to be verbalized) or explicit (readily accessed, verbalized, or articulated—even in documents). New knowledge creation processes are fuelled by the perpetual transformative motion between these two states, as Nonaka and Takeuchi showed in their famous "spiral model."[3] While the pair focused their interest on how to harness the power of tacit knowledge—for instance through socialization and the face-to-face, side-by-side sharing of experiences among colleagues—explicit knowledge has somehow been taken for granted. Moreover, not all tacit knowledge is best shared through socialization; it may need to be codified and made more tangible for the sake of transferability, transparency, and memorialization. Visualization can be a powerful way to give form to tacit and fuzzy knowledge and insights, and put them on a more concrete level. For instance, during a design project, have you ever tried to express in words how your users feel and how their lives are? You may have spent time with the users, following them in their everyday activities, thus gaining knowledge though socialization. But describing that to your teammates or customers proved difficult. However, as soon as you accompanied your explanations with pictures and videos of the experience, they probably understood right away what you tried to convey.

This does not mean that visual representations are always the best way to communicate all types of content, in every situation, and with any audience. There are many ways to communicate, and shifting to more visual means can help us when words and texts seem to fail us: It can only be good to have ready alternatives in our expressive toolbox. Our schooling systems seem to disproportionately favor textual and logical expression above all, with the negative consequence that the visual is relegated to "artistic" or "technical" disciplines. As a result, most adults are afraid to draw, because they feel they lack the talent. Obviously, you do not need to be an artist to be allowed to use visual representations effectively, in the same way you do not need to be a professional writer to be allowed to create texts. In most cases, diagrams, schemes, stick figures, rough sketches, and simple photographs get the job done.

Taking inspiration from Carliner's idea that good information design (which very often includes a visual aspect) always works on physical, cognitive, and affective levels[4], I have classified three similar roles for visualizations in innovative, passion-based work: an affective, a cognitive, and a collaborative role.



Affective visualizations help us to empathize and make others empathize. They appeal to our visceral emotions and intuitive, holistic understanding. These types of visualization can be used, for instance, during and after user research: as visual prompts to facilitate interviews and workshops, as user-generated materials, or as photographic and video documentation of your fieldwork.

Cognitive visualizations, instead, help us in thinking, understanding, and analyzing. They appeal to our analytical skills and help us to find and see patterns, links, and relationships in data, as well as helping to envision ideas. They can assist our thinking perceptually, by presenting otherwise invisible information more clearly and also generatively, as we can often think-by-doing and think-by-drawing.

Lastly, collaborative visualizations help us coordinate our work, ideas, and goals with others. Shared visual representations help in integrating contributions from different actors, as well as structuring discussions constructively and making sure that everyone is on the same page. Collectively created and edited visualizations, from whiteboard sketches to digital mind maps, help in shifting the discussion from "my idea" to "our idea," and focusing on facts, opportunities, problems, and common goals, rather than on "the messenger" bringing these bits of information forward. Of course, the boundaries among the different roles of visualizations are blurred, and teams may collaboratively use materials that are affective or cognition-aiding in nature. The difference is that, in this case, the emphasis is on achieving common insights and coordination rather than simply communicating.

One of the goals of this chapter is to persuade you to get over your imagophobia, and persuade you to more confidently use visualizations in a variety of the situations you may encounter in passion-based development work: from sorting and making sense of data to keeping track of project goals and timelines; from outlining an idea to communicating your insights powerfully to your intended audience; from enhancing the effectiveness of your meetings and brainstorming sessions to helping groups of diverse individuals achieve consensus.

Chances are that you already relying on visualization in your work, but you still manage convince yourself that you are "just not a visual person."

Affective visualizations to empathize and make others empathize

As any ethnographer or user-centered designer could testify, there is a big difference between what people say and what people actually do. Often users are not able to fully verbalize their experiences and needs, as well illustrated by the famous sentence attributed to Henry Ford, the man who brought cars to the masses: "If I had asked people what they wanted, they would have said faster horses."

Visualizations can assist innovators and designers in their need-finding endeavors in several ways.

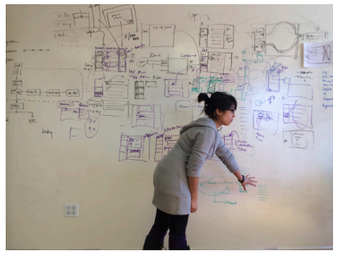
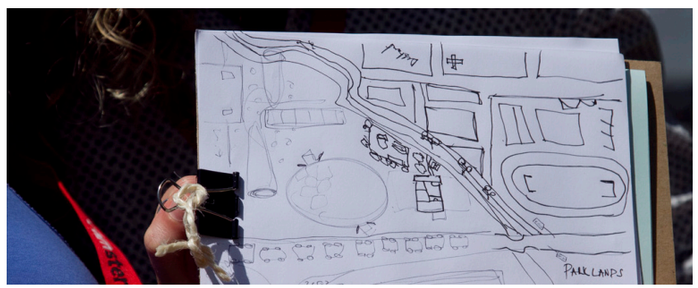
Firstly, visual materials can help users to better explain their feelings, experiences, and needs. For example, in user research methods such as cultural probes5, design probes6, and mobile ethnography[7],

participants are invited to take photos of exemplary situations that well illustrate their problems, lives, and experiences. Visual materials such as illustrations, photos, postcards, and cut-outs from magazines are often also used as prompts during interviews, focus groups, and workshops in order to help users convey their knowledge of their lived experiences and the contexts where these experiences take place[8]. In both cases, visual materials help the users to externalize highly tacit knowledge such as ideas, feelings, values, and beliefs. At the same time, they help the designers to see users' lives from a first-person perspective, fostering empathic understanding and leaving behind preconceptions and biases. Most importantly, they enable a meaningful dialogue between "the researcher" and "the researched."

Empathy, however, is not only necessary in communicating with users. Designers, innovators, and researchers often need to communicate their empathic insights about users' lives to teammates, customers, and other stakeholders: the empathy chain needs to become more far-reaching. Helpful techniques in these respects are moodboards, collages, and visual scenarios illustrating specific slices of life and situations.

In my experience as the lecturer of the Internship Innovation Project (called I2P) the most successful teams always share something in common: The visual clarity of their presentations is a mirror to the logical clarity of their arguments, which link and transform insights into smart solutions. Successful student teams take to heart one of my lecturing mantras: Document all your observations, interviews, and other interactions with the users' world through photos and videos (especially if you divide tasks and need to update the teammates who were not there). Great teams take this one step forward: Whenever we discuss their insights from research and I play the role of a skeptical client, the students are able to not only identify revealing quotes from their users, but they actually often show me photo and video materials that "prove" their understanding and framing of the problem is correct and powerful—the evidence is there to see and it reveals untapped potential for problem solving and innovation. The difference between good and excellent teams is the latter's ability to identify the image or video excerpt that can trigger an "a-ha moment" in their interlocutor, condensing the hard-won insights from user research into something deceptively simple to understand.



Cognitive visualizations as externalized aids to thinking

On both an individual and a group level, visual representations can also help us in thinking, solving problems, and making inferences and better decisions. While empathic understanding is crucial in sustaining innovation and design projects, analytical thinking is also indispensable.

Simply put, visualizations are useful thinking tools because they work as external cognitions[9], allowing us to easily "think on paper." Thinking and reasoning involves the creation of mental representation and the creation of logical links among different concepts, ideas, rules, and inferences. That is a lot of things to keep in mind! When we visualize, we store part of these mental processes externally, where information and relationships can be simply read off rather than juggled around in our brain.

The long history of humans using visualizations to make the complex simpler to understand is well exemplified by an idiomatic expression often used ironically in Italian: When trying to explain something perceived as simple to someone else and that person still does not seem to understand despite the explanation being repeated over and over, the frustrated Italian may be easily caught blurting out "Devo farti un disegno?" ["Should I draw it for you?"]. This hints at two things: first, there is a belief that drawing difficult things is a sure way to make them understandable to others; second, it also reveals an implicit bias—quite pervasive indeed in our formal education after kindergarten—against visual modes of expression, as if words and numbers should suffice for the intelligent, adult individual.

If we think about hard science, we immediately see how this bias is indeed silly, and visual communication is every bit as "serious" as words and numbers: Inarguably clever people such researchers, scientists, statisticians, and meteorologists customarily use visualizations as thinking and analysis aids in their everyday work. From simple sketches of molecules to sophisticated, interactive visual data displays, visualizing is a customary activity to support the process of discovery and making inferences. Coming back to the applied art and science of creative work, design, and entrepreneurship, thinking visually is a powerful tool in all lines of knowledge work. In fact, visual sense-making is so pervasive that we may be using it daily without recognizing its key role in our work.

Raise a hand if you have ever ...

... sketched mind maps to initially flesh out and get an understanding of problem or solution spaces.

... tried to make sense of different ideas by grouping sticky notes into distinct themes, creating an affinity diagram[10].

... tried to get a thorough understanding of an idea and its constituent elements by modeling it through service blueprints[11] or customer journey maps[7].

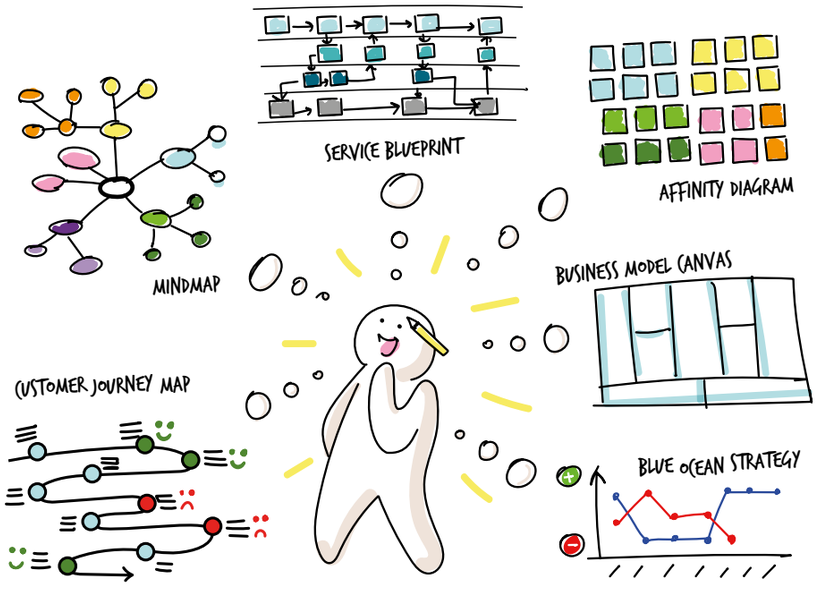
... used a Business Model Canvas[12] or a Lean Canvas[13] as a support tool to understand, systematically map, coordinate, and evaluate different aspects of a novel business idea.

... compared competing business models by plotting points of differentiation, strengths and weaknesses on a "blue ocean" strategy canvas[14].

This list of typical examples could easily be continued, but I am sure many of you already had a moment of recognition.

This is because creating and implementing new ideas constantly requires finding patterns, understanding relationships between elements, identifying and analyzing bottlenecks and opportunities, and (in general) bringing together new information and sustaining continuous learning. Visual communication is actually great in supporting these cognitive activities.

Highly conceptual and creative disciplines—such as, say, service design—would be simply impossible (or at least very, very difficult!) without the aid of visualizations. Service design is inherently visual[15]—even if the outcome may not be a visual artwork. The conceptually demanding process of bringing "orchestrated processes," interactions, flows and experiences into existence requires holistic thinking, which is characteristically well-supported by communication through visual and material means (that is, bidimentional and tridimentional representations and prototypes), as opposed to linear modes of expression and fruition such as writing/reading and speaking/listening.



So far, I've focused on visualizations, even though the activity of visualizing may even be more important in knowledge work—especially if the focus is on stimulating creative, lateral, and associative thinking and idea generation.

Doodling and sketching, alone and in teams, are a powerful way to open up new patterns of thinking. Far from being a waste of time for serious adults trying to solve serious problems, sketching is a boon for creative problem-solving as it helps to reinterpret information in novel ways and more easily recall earlier ideas and thoughts[16]. Drawing is often used in brainstorming as an alternative to simply writing down ideas because "making something" forces you to make decisions and be less vague about its details[17]. These beneficial effects not only apply to the stereotypical creative, designer types: a study by Bresciani and Eppler[18], for example, demonstrated that groups of experienced business managers were also able to generate more and better ideas in team meetings when they used visual methods to document and structure their ongoing discussion.

Collaborative visualizations as tools to work better in diverse, creative teams

Since innovation projects tend to be messy and highly uncertain, keeping all team members on the same page is crucial to ensure constructive dynamics and continuous progress. Visual representations can help in coordinating, finding synergies, discussing complex topics in a structured manner, and moving the discussion from persons to issues.

The challenge of creating and maintaining common ground throughout the project is especially sensitive when teams are multidisciplinary and geographically dispersed as this make it even more difficult to establish what everyone knows and thinks.

In order to successfully collaborate, diverse individuals need a common language, shared meanings, and agreed ways to negotiate disagreements and create new knowledge[19]: as a cautionary rule, it is good to assume that different team members are not always on the same page when discussing abstract, complex, fuzzy concepts. Each individual will create different mental representations of what is being talked about. Creating a tangible, visible visualization is the surest way to create an actual common referent and avoid falling into the fallacious "... but it's self-evident!" line of thought (self-evident may, after all, mean that something is evident just to oneself).

Several studies on cross-disciplinary collaboration in product development[19,20] illustrate how prototypes, blueprints, and CAD drawings are indispensable tools of the trade for salesmen, design engineers, manufacturing engineers, and production technicians to express their perspectives, understand each other, and coordinate their diverse efforts in delivering great new products to customers.

Organizational studies on collaboration are full of examples of these so-called "boundary objects," artifacts that aid multidisciplinary work by offering a way to bridge knowledge boundaries between different professions. Visualizations—such as maps, blueprints, models, prototypes, and diagrams—and their ability to help bridge knowledge gaps are a familiar presence in this stream of research. An important feature of these "objects" is to be flexible and robust at the same time[21]. Simply put, a true boundary object offers robust rules for its use and interpretation but also allows different professional groups to flexibly use it on their own terms and for their own goals. As a concrete example let us think about a blueprint: its robust role is to illustrate what the final product should be and what specifications to follow. Its role will also adapt flexibly to the needs of different professionals: for the designers it will constitute the main deliverable and outcome of their conceptual work on form, fit, and function; the engineers will assess the blueprint to figure out its manufacturability and technical feasibility; for the assemblers the blueprint will work as instructions but also the starting point for solving their own challenge of figuring out the best and fastest production process.

Visualizations often play a boundary object role, and, in general, it is good to remember that boundary objects do not only support collaboration around the solution being created. They also support collaboration on a meta-cognitive level, helping the team keeping track of what they individually and collectively know (and do not know!) and where they are in their innovation process. Using the I2P course again as an example, I have observed how teams who are able to document (at every step of the project) their knowledge in tangible and explorable ways—for instance, through canvasses, user journeys, and analytical diagrams—ultimately succeed in having more insightful discussions within the team and also with their coaches. Even when the people involved disagree, visualizations make it easier to propose and substantiate alternative perspectives or simply jointly arrive to a completely new and shared perspective together.

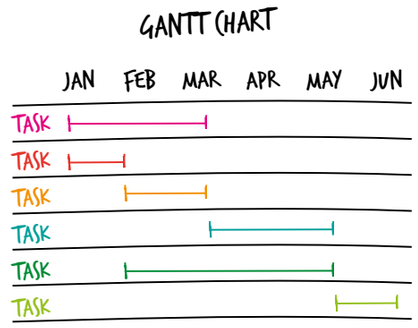
I2P students sorting the 120+ ideas generated during an ideation workshop with the affinity diagram technique.

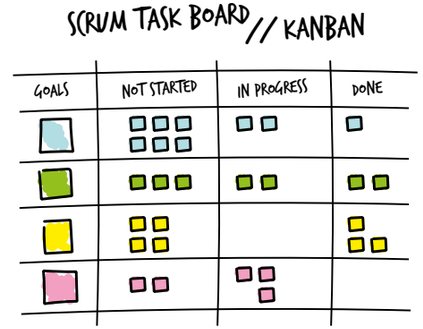
When I coach my students, visualizations are also indispensable for me to understand the thinking process of the team, their assumptions, the reasons for their chosen focus, and how they arrived at those conclusions. As said, good communication should also be achieved beyond the boundaries of the team. Visualizations document the creative and analytical evolutionary journey of a team and their ideas: Having the opportunity to gaze into the intellectual backstage of a creative project is invaluable in giving more accurate and useful advice, and ultimately helping the team to succeed.

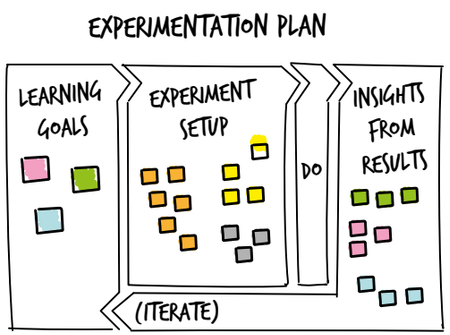
Lastly, visualizations play a helpful role in managing creative projects, which are often highly uncertain: In addition to factors such as multidisciplinarity and geographical distribution, student teams at Aalto Design Factory (ADF) often need to grapple with open, ill-defined briefs, and a lack of knowledge as to what a valuable, desirable final outcome should be. Creative and innovation processes are also often intrinsically iterative, explorative, and nonlinear, contributing to the nagging feeling of being, at times, quite lost in one's own project. Simply put, a modicum of certainty about roles and activities is needed, even in the most uncertain, iterative, creatively wild project. A good example is offered by process representations, such as simple timelines and Gantt-charts[22], or more sophisticated to-do dashboards like kanban or the scrum task board. Within the scope of I2P, my colleagues and I provide the students with tailored time-management tools such as the week-by-week masterplan and the experimentation plan[23]. These tools can greatly help teams in conceptualizing and monitoring progress and productivity, managing contingencies, and in general being better aware of the interdependencies between team members.

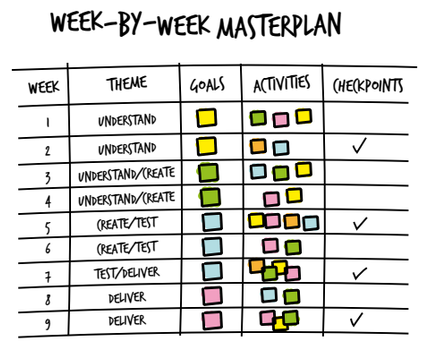
Conclusions

The more the outcome of our work becomes conceptual, complex, and intangible, the more we need "material," perceptual, rich ways to envision and communicate it. In this short chapter, we saw several examples of how visualization is becoming pervasive as a communication and coordination practice in passion-based, creative work for different purposes and for people at all skill levels. The take-away message is that artistic talent has nothing to do with effective visual communication: Rough sketches and stick figures can go a long way in solving problems or making a point[24]. Visualization methods and visualizing practices constitute powerful tools for innovators to foster empathy and shared understanding with people around them, collaborate more effectively with colleagues, and boost the capacity for both creative and analytical thinking.









PROTOTYPING THE PROTOTYPE

Brokering innovation projects

Anita Kocsis, Alicen Coddington, Anne Prince, Colin Giang, Nicole Symington, Alex Graham, Alison de Kruiff, Carl Turner, Pauliina Mattila, Christine Thong, John Eggleston

Key points

- Prototypes are boundary objects that help to translate, facilitate, and transform ideas across multiple and diverse teams
- They reduce the risk of misinterpretations by illustrating tangible and intangible knowledge, helping to create shared meaning
- Even low-fidelity prototypes help to tell stories and, when created jointly with different stakeholders, they can embody collective knowledge
- Documenting prototyping facilitates additional learning, capturing new knowledge beyond that of visual knowledge and written text

Verbal, written, and graphical modes of communication are all popular and widely used but rely on the recipient's interpretation of the words or the sketch. Interpretation is therefore open to misinterpretation, which may lead to a loss of information that is important to an outcome. Feedback becomes ambiguous as communication relies on an individual's ability to explain themselves with what may be limited oratory or sketching skills. One-to-many models of transmission add complexity to communication when compared to one-to-one conversations, and in the case of a project team, the synthesis of important components or ideas may get lost.

Prototyping, no matter how rough, greatly improves communication by reducing ambiguity and the potential for misinterpretation. A prototype is an artifact built to see if a particular solution solves a given problem[1]. They traverse low-fidelity representations in the initial stages of designing and high-fidelity

realizations when design outcomes are near finalization, and they can include elements of haptic, oral, visual, and graphical forms of communication. Prototypes are created not as a final outcome but as a tool to further the design process through experimenting, communicating, and building experience[2]. In this way, a prototype is a conversation related to design as it communicates "what has happened, what has been suggested or revealed."[3] Prototypes create a greater understanding of a design by acting as interpretable artifacts that engage project team stakeholders in discussion and storytelling[4]. While not everyone believes that they can draw and not everyone speaks the same geographical or professional language, everyone can take an object and act out a story or scenario of use related to that object. In this way, the activity of producing a prototype reduces confusion and disseminates concepts and agendas within the project team. This in turn helps the project teams to understand the needs of users.

Within innovation practices, prototyping is an iterative process that "helps designers refine their ideas and discover previously unknown issues and opportunities."[5] A prototype can also be understood as a mindset in which designerly activity takes place[6]. Designers create prototypes to gain a greater understanding of user needs and improve the collaboration between stakeholders, such as other designers from the same or alternate design disciplines, clients or partners, and user groups. The prototype's role within the design process can help define an idea, a style, experiences, and implementation. "Prototyping practices oscillate between creation and feedback: creative hypotheses lead to prototypes, leading to open questions, leading to observations of failures, leading to new ideas, and so on."[5] Prototyping leads to the generation of knowledge through building and testing innovative hypotheses, facilitating an iterative communication process between the various stakeholders of the co-creation process. Prototyping is "an activity that both designers and co-designers can engage in during all phases of the process."[4]

Prototypes as brokers in co-creation

Prototypes can provide a perspective on complex problems in ways that extend the vocabulary of traditional writing and verbal communication. Prototypes are key to creating a collective understanding of the problem context[7] in co-creation. Creating shared meaning, however, is problematized through the ownership of meaning. The ownership and various perspectives of meaning are socially negotiated, producing an economy of meaning, power, and knowledge[8]. Prototypes can act as brokers in this complex landscape. Brokering "involves the process of translation, coordination and alignment between two perspectives,"[8] with co-creation comprising "competing voices and competing claims to knowledge, including voices that are silenced by the claim to knowledge of others."[9] Prototypes and prototyping act within this contested landscape as vehicles to facilitate and negotiate with the competing voices, working towards shared meaning.

The idea of a prototype as broker is derived from Lave and Wenger's theory of communities of practice. Communities of practice are characterized by "mutual engagement, a joint enterprise and a shared repertoire" to the extent that individual contributions are no longer independent activities[8]. Communities of practice theory argues that where information is used by multiple groups, the form of the intersection (the boundary object) between distinct fields of knowledge is crucial to the development of shared meaning. Boundary objects are "both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites."[10] Further, boundaries represent opportunities for transaction and the creation of new knowledge. They are places where the unknown and unexpected are realized and where old knowledge is renewed in untested, radical new forms.[8]

There are many ways to use a prototype as a broker in co-creation. First, prototypes can be developed individually or with a team and presented to stakeholders for review. Thus, prototypes can act as communication tools for illustrating intangible and tangible knowledge that can influence the decisions about the direction of the project. Prototypes of higher fidelity are used to communicate the final design and outcome of the work. Secondly, a prototype or series of prototypes can be used to tell a story where the prototype becomes a prop in an acted scene that describes a user in a functional scenario or in the iterative cycle of the prototyping process. This type of communication suits the lower-fidelity prototypes that serve more as imagination prompts than desirable representations. Finally, a prototype may be built directly with stakeholders, where each leaves a mark on the prototype and the physical creation comes to embody the collective knowledge. The process of making in this last instance is important as co-creators are communicating through the prototype while building the prototype. Prototyping in this context is a co-creation activity and it embodies the process of collaboration. This chapter presents three key benefits of brokering and cases of co-creation projects in order to illustrate the power of prototyping in facilitating communication.

1. Prototyping to create shared meaning within a project

Prototypes as boundary objects are the brokers between the project stakeholders but also traverse the boundary between the stakeholders and the project outcome. Prototypes seen through this lens are a mechanism for brokering meaning and knowledge through making, doing, and building. Prototyping can become a universal language to facilitate contestation, divergent thought, and cultural difference and it is vital for co-creation outcomes that include translation, facilitation, and transformation. Shared action alone will not create cohesive team direction—a mediating instrument is needed to augment communication and decision-making processes. Prototyping facilitates interdependency and common purpose with a project team as the prototype acts as a focal point of activity.

Prototype resolution is typically categorized in two ways: low-fidelity prototypes and high-fidelity prototypes. Low-fidelity prototypes are rough representations of aspects of a concept that allow a team to quickly build, develop, test, and discard early concepts. Conversely, a high-fidelity prototype is a highly realized output at a given point of time of the project. In the journey from rough realization to finalized outcome, prototypes demonstrate the evolutionary journey of a project. In most projects,

prototypes begin as rough, low-fidelity concepts constructed from paper, cardboard, or found items, allowing teams to quickly test the basic functions and intentions of the idea, omitting visual polish for immediate practical feedback. As the prototypes are tested, iterated, and improved, the visual and functional precision increase and the focus of the prototype begins to converge. Towards the later stages of a project the prototype may possess all of the functional and visual qualities of the intended design outcome and be produced as a working high-fidelity prototype.

The varying fidelities of prototypes serve different purposes as brokers of communication and boundary objects within projects. The early low-fidelity prototypes foster shared understanding of the problem space, prompting activity towards exploring numerous possibilities and establishing channels of communication for a new team. As boundary objects they serve different purposes depending on the knowledge and roles of the individuals in the team. They may show the desired shape for a hand-held device, show that the basic functionality will be useful for the target audience, or show that it will fit in a pocket. For higher-fidelity prototyping in later stages, the prototype helps refine agreed upon solutions, serving as a focus for team skills by embodying collective knowledge. The brokering of communication evolves beyond establishing agreement on the problem space to collaboration on a solution. The high-fidelity proof-of-concept prototype evidences the group consensus and final understanding of the project.

Case: Finding common ground in a museum project

It quickly became clear that there were knowledge differences in the interdisciplinary team charged with presenting scientific knowledge to museum audiences in Realising Einstein's Universe, a stereoscopic 3D animation project at the Museum of Victoria, Australia. The scientists, historians, programmers, exhibition staff, and designers were clear about the exhibition mission yet unclear about the exhibition outcomes. Complicating the project further, the team, excluding the scientists, had insufficient scientific knowledge. To address these differences, prototypes were used to facilitate expectations for the project as well as "facilitating transactions between the two practices," with the team introducing "elements of one practice into another"[8] through prototyping. Analysis of the team's expectations of the audience as the users revealed differing and at times opposing notions of who is the audience or who are the visitors in a museum context. The prototyping of the physical exhibition space and the digital technology in themselves positioned the "user/visitor" in the boundary encounter. Prototyping enhanced knowledgeability—in other words, "a person's connection within a multiplicity of practices"[11]—within the project team.

In Realising Einstein's Universe, prototypes helped to broker understanding across these differences in order to create shared meaning. Prototypes (including drawings, paper mock-ups, and digital elements) were built over time for team communication. Prototyping facilitated the brokering across the diverse stakeholders, the communities of practice, but also unintentionally brought focus to the role of the visitor experience. This shift in focus to the visitor became key to the final outcome of the project, adding another stakeholder group into the team discussion. Prototyping brought understanding and appreciation of what visitors experienced. It enabled the museum to consider new approaches to explain digital content inside the exhibition site as prototyping encouraged the team to build-to-think, not just think-to-build. These activities resulted in new knowledge pertaining to the spatiotemporal impact on the visitor and also changed the direction and the materials used in prototyping.

While traditionally low-fidelity prototypes occur at the beginning of a project and high-fidelity prototypes occur at the end (in order to demonstrate realized concepts), this case had a different prototyping trajectory. The project team started with high-fidelity prototypes in order to communicate the digital technology and the content of the exhibition. These high-fidelity prototypes took the form of digital interactive interfaces and projections. The project team then reverted back to low-fidelity prototypes. These low-fidelity prototypes took the form of cardboard models constructed to better understand the visitor's influence in the exhibition space. It became evident through the iterative cycle of high-fidelity prototypes that the user/visitor took precedence over the technology outcome of the exhibition design. Prototyping in this context empowered the team to consider how visitors receive, consume, and contribute to an exhibition. Learning from this revealed that expectations with regard to how a project should progress and the type of prototyping that should be used to communicate are in constant flux. Project teams need to be open to changing the material and fidelity of the prototyping for the sake of the project outcome and the team's internal and external communication.

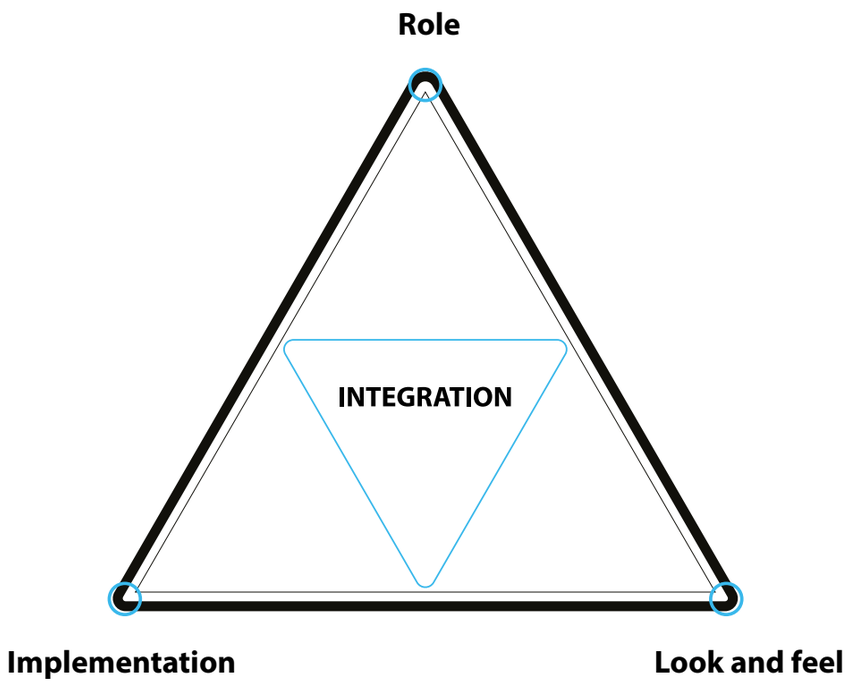
The prototypes communicated across science, exhibition design, programming, scientific formula, historic content, and marketing. Prototyping established a shared set of analytic tools through which the stakeholders drew together, producing new community of practice knowledgeability not easily accessible by the individual participants within the project team.

2. Prototyping to communicate tangible and intangible knowledge of the project

For industries collaborating with students at Design Factories, prototyping is a useful conduit for communicating across different professional (industry) and student (academic) perspectives. At the fuzzy front end of the design process broad, open-ended questions are the norm. These briefs are ambiguous and challenging for all stakeholders. The briefs are designed to be ambiguous and are also considered risky by businesses who are more comfortable working with narrow briefs with achievable and well-defined goals. However, ambiguity at the start of the innovation process aims for richer outcomes as it provides the freedom to understand the problem and identify any gaps that may be hidden.

Communicating through prototyping becomes increasingly multifaceted when communicating with someone outside the initial context. Some characteristics may be uncommunicable.[12] When thinking about what the prototype is in fact communicating,

a classification system created by Houde and Hill[12] becomes handy (see the picture below) for clarifying what information the prototype is intended to convey. This classification provides an orderly way to convey to outside audiences the purpose of the prototype at the time of creation. It can guide designers in selecting an appropriate mode (oral, visual, or graphic) of prototyping.



Case: Prototyping as the only constant in an ambiguous project

For industries collaborating with students at Design Factories prototyping is a useful conduit for communicating across different professional (industry) and student (academic) perspectives. As mentioned above, the ambiguity at the fuzzy front end of the innovation process can lead to richer outcomes as it provides the freedom to understand the problem and identify any gaps that may be hidden in more constrained research projects. While ambiguity can lead to radical innovation, it is also considered financially risky by businesses that are more comfortable working with narrow briefs with achievable and well-defined goals.

The difficulties of having an ambiguous brief were experienced in a project involving Design Factory Melbourne, Aalto Design Factory and an industry partner working on a ME310 program. Participating in this program was initially confronting and foreign to the industry partner—as a large business involved in the packaging industry, research and development largely consisted of iterative changes to existing products or economizing existing process. Having recently licensed a new innovative dispensing technology, the industry partner sought help in scoping potential applications. The brief delivered to the student team was open and required the identification of a commercially viable application for the technology with few constraints to direction.

Traditionally the industry partner conducted research through analysis of market data and identification of consumer trends. Additional innovation around packaging design was conducted by a small design team for client-specific projects. In these processes, digital models were used in the early stages of development. Prototyping was not used until late in development when it was used to demonstrate the outcome for review, and in these cases high-fidelity prototyping was an expensive endeavor. The industry partner prioritized risk mitigation, cost benefit analysis, and outcomes that would be commercially successful over prolonged and deeper need-finding exercises. Thus, high-fidelity prototyping was not seen at the pre-production stage and physical prototypes were not used as a tool to scope user's needs.

The process used by the student teams stood in contrast to the industry partners traditional process as project prototyping was employed from the outset. As a result, the definition of prototyping changed for the industry partner as they observed the use of low-fidelity experiential prototypes in the research process. Low-fidelity prototypes not only progressed the product development with users during the user-centered design process, they also built trust and brokered understanding of and assumptions about the ambiguous brief. Both the industry partner and the students in the team had to learn to communicate effectively in order to reduce the ambiguity of the process and understand the needs of all stakeholders. Prototypes were an effective means of communication. However, as using low-fidelity prototyping as a form of need finding, problem solving, and user research was foreign to the industry sponsor, only the global student team were conscious of what information the low-fidelity prototypes were conveying.

Within this case, boundary encounters between stakeholders were initially strained. Houde and Hill's classification system for prototyping was useful in acknowledging what the project team and the prototypes were communicating, be it role, implementation, look and feel, or a combination of

these. Providing the context mitigated miscommunication and aligned project direction. The physical properties of the prototypes helped to reduce the ambiguity of the innovative ideas being proposed by the student team in their research. The physicality of the prototype embodied the knowledge gained from user testing. The physical objects could be used in acted scenarios to demonstrate the concept to the industry partner, additionally allowing them to become an actor as well and contribute to the research. On the other hand, having physical prototypes allowed the industry partner to pass their professional knowledge back to the students by identifying better ways to construct and design packaging, as well as optimize the design for a more efficient and commercially viable production outcome in the later stages of the project. Finally, strong communication through prototyping alleviated the industry partners concern for success by demonstrating that a functioning physical product, despite being of low fidelity, was achievable.

Learnings from this case identify how prototyping brokers not only the assumptions of a brief but also how it reinforces how individual knowledge can become shared knowledge, forming the knowledgeability of the community of practice. Being on the same page is important in order for stakeholders to operate cohesively. Getting to be on the same page requires communication and the acknowledgement of the purpose of the prototyping activity and the prototype as an outcome. The brokering of knowledge provides a more unified environment where risk, failure, and trust are accepted and create the conditions for innovation to occur.

The prototype progression of "Paintpac," from low fidelity to working mock-up.

3. Documenting prototyping to enhance project health and learning

In addition to creating shared meaning, prototyping is an ongoing tool to monitor and also affect project progression. The variety of prototypes constructed during a project record the twists and turns of the pluralistic non-linear routes of the project's investigation. Prototyping through the life of a project can reveal clues about the dynamics of the team activity: the communication models, forms of creativity, experimentation types, the direction of the ideas, and the resolution. Prototypes also represent how a project has progressed, developed, and altered over the course of the project in a visible format through documentation. The unspoken celebrated and contested moments, and ongoing concrete and unrealized ideas are evident within prototypes.

Prototyping simultaneously acts as a tool to mediate, communicate, and direct dialogue, and also serves an additional function as a proof-of-concept between all stakeholders. Mapping the routes and modes of enquiry provides value, depicting key embodied knowledge from the contextual problem space and design practice. A prototype embodies the investigative space and the context of the project team at the point in time of its creation. A prototype can be viewed as a structured map that depicts the project iterations and development but, more importantly, it depicts the spaces between and the methods used, as well as the prototypes themselves. "Knowledge and skills can be transferred [...] indirectly by embedding them in objects. Thus tangible products can be viewed as embodied knowledge or activities."[13]

In Design Factory Melbourne projects, the knowledge formed through prototyping is often transmitted in the form of a textual report and documented images, which are as highly valued by the industry partner as the final proof-of-concept prototype itself. However, there is further potential for knowledge to be embodied within the document of the prototypical journey. In the act of building a prototype, embodied meaning is formed through physical and exploratory activity, as in Frayling's (1993) Research for Art and Design (understood today as Research through Design)[14]. In addition, it is part of a continuous conversation (as in Schön's "reflection-in-action"[15]) in the process of bringing an idea to an outcome. When viewed through the understanding of Schön, reflection-in-action creates a continuous conversation and reflection. A prototype and the act of prototyping are—to again borrow the words of Frayling: "a tradition which stands outside the artefact at the same time as standing within it."[14] Prototyping is a process that allows symbiosis to exist between doing and reflection.

We argue that through documenting, the nonlinear process of prototyping provides contextual information and becomes a different vantage point from which to interrogate the project and its outcome. Iterative prototyping also assists future teams in distilling the embodied knowledge of the prototype by acting as physical documentation of the decision-making process that led to the final deliverable[16]. As depicted in the cases above, the mapped examples of prototypes and prototyping highlight reflection-in-action as they demonstrate the journey of knowledge gained by the teams. Reflection-in-ac-

tion provides the structure to understand and reflect upon a project development. It is through the process of "remembering and recording through the prototyping this moment of knowing starts on the path to becoming collective knowledge."[3] When viewed from the position of hindsight, the prototypes represent not just the evolution of the product but also the health of the project. However, in the moment of the project this is not possible. Hence, the power of the document lies in it being a further form of learning, reflection, and communication. Prototyping can both increase the health of the project for its duration and the long-term capability of the team and organization, as the learnings from individual projects are carried on to the next effort.

Case: Trust and ownership in a distributed project team

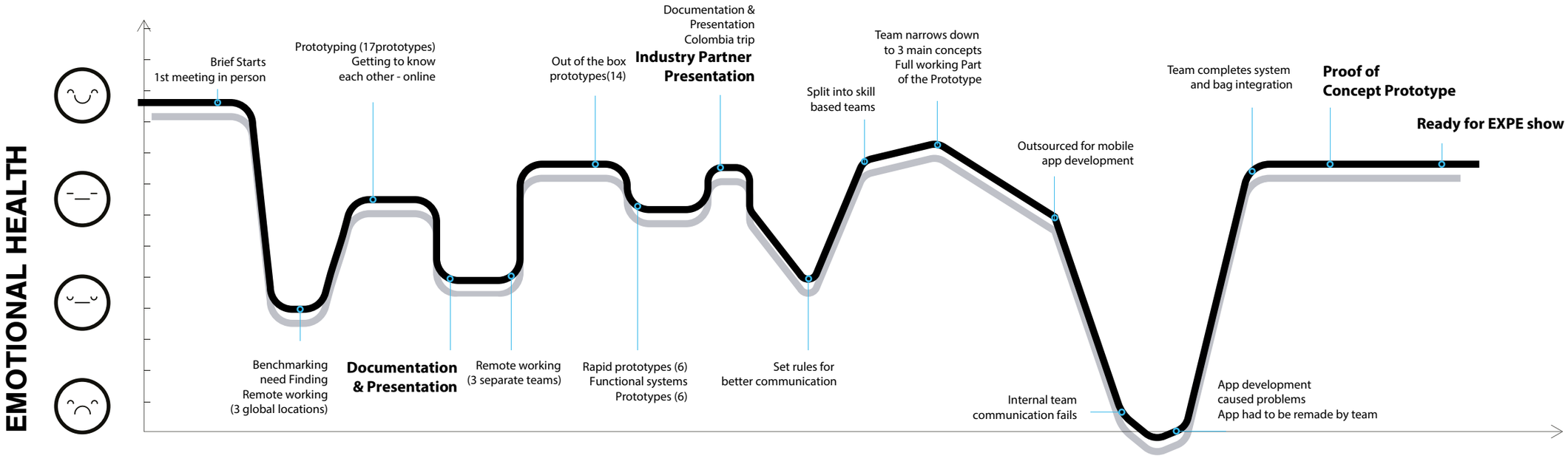
Another student project between Design Factory Melbourne, Pontificia Universidad Javeriana (Cali, Colombia), and Stanford University (California, USA) used a rapid iterative design process to develop a product. The process provided moments of contestation. The project brief contained numerous criteria and agendas. This made for rough ground from which to launch the project. The level of criticality made it difficult for the international project team to trust, contribute, and feel ownership of the brief. Adopting prototypes early was a mechanism to build and foster the project team's dynamics and willingness to contribute.

The critical factors of sustainability, customizability, efficiency, and technological advancements were viewed as the non-negotiable elements of the project. This required the project teams to use prototyping as a way of immersing themselves in the product in order to understand their own capabilities, to empathize how the target audience responded to the technology, and to ensure the industry partner could engage with product opportunities. For example, a smart bag that communicates to its owner was prototyped in multiple forms and segments. These prototypes were manifested not just through the traditional build-and-deliver model of thinking but were also dramatized (see the picture on the right). The act of wearing and engaging with the technology was experienced and enacted as a form of prototyping and user testing. To prototype in such a way not only built empathy for the end user but also provided a tangible experience with which to continue the conversation amongst stakeholders. As Downton notes, "It is always possible to imagine a different outcome; the degree to which this is difficult. That apparent 'rightness' of the design work, is a measure of the sense that a different outcome would be no better or not as good as the one that is presented."[3]

Multiple prototypes for the project informed the final deliverable. In total 44 prototypes were constructed throughout the life of the project. Every prototype—either oral, visual or graphical—informed the final proof-of-concept. More importantly, the prototypes managed the stakeholders' expectations that impacted on the final design. The prototypes were physical outcomes of the production phases. Examining the documentation in hindsight gives clues to the team dynamics. Prototyping by the team helped to create trust whereas the absence of prototyping eroded trust, feelings of safety, feelings of ownership, and feelings of responsibility. This critical point in the team's emotional health occurred when the team lost ownership of the prototype. Here prototyping shifted from prototyping-as-process to a focus on the prototype-as-outcome.

A timeline of the three stages in physical prototyping running from the start of the process to the proof-of-concept

The shift occurred because the proof-of-concept required a high degree of technical and digital knowledge that the team did not possess. The team outsourced the prototype to a new team with specific competency in this area. However, handing on a part of the prototype stifled the communication and many tacit and overt components integral to the function and outcome of the final proof-of-concept were lost and misunderstood. In the final stage, when the team took back ownership of the prototyping, the team's emotional health and cohesion towards an outcome was delivered. Learnings from this case show that while prototypes are communication tools, they may be difficult to transfer to outsiders as each team's models of communication differ. Due to the project constraints or team capabilities, a project team cannot always deliver a finalized, high-fidelity prototype. Therefore, communicating the desired output to externals is a challenge. This is where the documentation of past prototypes and being explicit in your requirements is important.



Prototypes as brokers and beacons in practice

In conclusion we offer the following considerations for applying prototyping to mediate teamwork in ways beyond the capabilities of oral or written communication. Prototypes and prototyping are focal points of activity and communication, making abstract ideas tangible. By providing a channel for continual experimentation they document progress in a project, indicating where knowledge is gained, where changes of direction occur, and where design leaps from the problem space to the solution space.

For the practical implementation of prototyping as a broker and boundary object, it is worth noting the following:

• Prototyping should be used from the very start of the project. Early stage prototyping assists with establishing trust, communication, and creating a shared understanding of the problem space in a team. By using early-stage prototyping teams engage in building-to-think, not just thinking-to-build.

• Prototyping should be conducted regularly. Through repeated prototyping sessions teams develop a shared understanding, strengthen communication channels, and respond collectively to any changes in project direction. Regular prototyping acts as a form of documentation, embodying all research and knowledge in the project but also serving as a way to look back and chart different stages of project development and teamwork.

• Prototyping should involve all team members. To foster shared understanding and augment communication, the prototype should be the focal point of all team members working on the project, not just the focal point of the designers. By involving all team members, prototyping actively transforms collective knowledge into a tangible manifestation.

PHYSICAL REPRESENTATIONS AS A COMMON LANGUAGE

Facilitating communication amongst service stakeholders

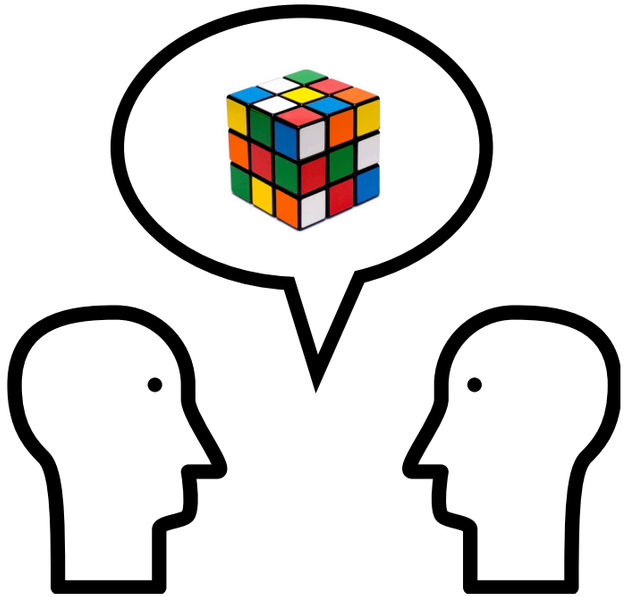
Samuli Mäkinen
Pia Hannukainen
Sampsa Hyysalo

Key points

• Successful service design requires awareness of the various, often remarkably different, constituents of a service for different stakeholders. However, the intangible and complex nature of services adds an extra layer of trickiness to endeavors.

• Giving services a material form allows for transferring knowledge amongst and between different stakeholders: they make service elements and their relations visible and provide a common referent.

• Quick, easy-to-use, and inexpensive techniques help service designers and managers who are bound by limited resources. In the spirit of early prototyping, we recommend utilizing such approaches before jumping into more resource-intensive methods.



Understanding intangibles

Without sufficient awareness of how different stakeholders perceive services, service designers can overlook stakeholder needs and design opportunities. This is particularly the case with customers. The benefits of customer involvement in service design are widely noted[1-6]. However, to support this involvement, more appropriate visualization tools and techniques are yet needed[7,8]. This is particularly crucial in collaborative service design efforts to counter the false common ground effect, "a cooperatively constructed mental abstraction, available to no one,"[9]—in other words, fertile grounds for confusion. Collaboration-related issues also account for the majority of critical success factors in the development projects of tangible products[10]. Misunderstanding the requirements of customers in service design[11] and misunderstanding users' preferences and needs in R&D altogether[12] have been persistently reported as major reasons for failures. For instance, in a study of circa 90 000 IT projects, the relations between the development team and other stakeholders was the most critical factor differentiating between successful and unsuccessful projects[13].

A key reason for the need for tools and techniques to visualize services lies in the very nature of services. Most services feature some degree of intangibility, heterogeneity, perishability, and inseparability[14,15] as well as interactivity, complex (digital) technology, and organizational relationships[16,4]. These characteristics, combined with varying use contexts related to individuals' lives as opposed to designers' estimations of them, result in difficulties in explicating what constitutes a service. This is also a thorny and frequently encountered issue in practice. To elucidate the problem, Gregory Bateson's[17] parable of a blind man and a stick, "going tap, tap, tap" reminds us that it is not always that obvious where one entity begins and another ends: Does the person begin at the fingertips, at the end of the walking stick, or perhaps at the synapses leading to his brain from his fingers?

Approaches for user involvement may offer some remedy to these challenges—although terminology often differs (e.g., customers, consumers, or clients are often discussed instead of users, the major distinction being the possibility that a customer may buy a service or product without actually using it). However, despite the past growth in service development literature, the amount of studies focusing on customer involvement in service design[1,3,6] remains limited[1,4]. It has also been noted that the design, visualization, and simulation of services require new perspectives as well as appropriate tools and techniques[7,8]. While several user involvement approaches rooted in new product development may be applied in the development of services as well, the unique characteristics of services presented above can complicate matters. In addition, the tendency of services to involve users in longer and more intimate commitment suggests that involving customers may play an even more important role in service companies than in companies producing tangible products[1].

There is a multitude of methods for gaining a deep and extensive contextual understanding of service use, with ethnographic methods probably being the best. However, with these methods—such as field observation and interviewing, or more comprehensive approaches such as contextual design[18]—the time and occasions needed to map different versions of service-use alone would easily comprise a small research project. The process requires intensive use of time and other resources for both gathering and analyzing the vast amount of created data, such as page after page of notes and transcripts or hours of audio or video recordings. These methods tend to also require skills and competences that are often lacking in a company. Educating employees inside the company or buying the required competence from outside can easily become expensive. This results in taking shortcuts, where methods that are known in the company are applied even when they do not necessarily fit the purpose. For example, group interviewing[19] or focus groups[20,21] tend to run into problems regarding how to effectively and reliably keep track of the service elements expressed or how to keep a stakeholder group aware of what they have already considered. On the other hand, tools for involving users—such as service blue printing[22,23], story boards, or customer journey mapping—tend to only focus on specific aspects of a service and are rarely lightweight to implement.

It seems only natural that companies tend to utilize tools that are not complex and that require less effort to understand and implement[24-26]. Jin et al.[26] show that perceived ease of use and resource commitment positively affect organizational adoption of service development tools. This chapter illustrates the benefits of using physical representations in a collaborative manner to elaborate the understandings of services. We present two recent techniques in order to showcase the use of physical representations designed to make the varying stakeholder understandings visible via making services tangible. As our examples show, such collaborative physical representations can be applied for a multitude of purposes, ranging from understanding a current service to envisioning new ones.

Collaborating through physical representations

Various kinds of physical representations[27]—such as sketches, models, or prototypes—have long been used in supporting different design activities, mostly for generative design efforts for tangible products for which the value of user or customer involvement has long been acknowledged. There are also examples of dealing with the intangible, and today physical representations are extensively used in contexts such as socio-technical systems design, service design[28], experience design[29], designing for social interaction[30], software[31], commercial spaces[32,33], business models[34-36], and organization strategy[37].

As discussed in the previous two chapters (Show, don't tell! and Prototyping the prototype), working collaboratively on a physical object can help to bridge boundaries[38], and prototypes and visualizations have their roles as thinking and communication tools[39,40]. A traditional prototype is likely to be the most concrete form of physical representation, and this type of physical model is a demonstrative vehicle for sharing and experimenting visions of physical products. Using low-fidelity prototypes without any functionality (in other words, mock-ups) to represent a feature further lowers the threshold for user participation as they encourage hands-on experience and the mock-ups are understandable, cheap, and fun to work with[41]. Brandt[39] explicates the advantage of physical representations in the case of mock-ups: "tangible mock-ups are perceptible by more senses than models on paper and in computers, and because

of this, they seem to evoke more reflections from each individual participant." Hands-on activities help relate technological concepts through improving short-term and long-term memory with the greater use of visual, auditory, tactile, and motor memory[42]. In addition, quickly assembled and easily adjustable physical representations allow for quick iteration, participants' building on each other's ideas, and flexibly changing the level of detail and focal points of attention, as well as dealing with the system as a whole in an easy-to-grasp manner[39,43-46].

Collaborative design features a large family of techniques and methods that take place in workshops and utilize representations of work and technology to translate information and understanding between developers and users[47-49]. Tangible business modeling, for example, is a method wherein businesses, collaborative relationships, and/or value propositions are translated into a playful and functional physical model. The model is then used with or by stakeholders for the joint exploration of artifacts, arrangements, or a service to support it[50,51]. Collaborative design games are another track to follow among the collaborative techniques. They have been built for multiple purposes and with notable variation; for instance, in envisioning information system make up and work redesign[52], in design opportunities[53], in exploring data for service design and collaboration opportunities[54,55], and in creating shared images of the prospective users of a new technology[56].

Stigliani and Ravasi[57] found that the "materialization" of cognitive work supports the collective construction of understanding. Different tangible artifacts support the conscious examination and elaboration of emerging interpretations; enable the drawing of connections between early ideas and their integration into more complex mental representations; facilitate the exchange of feedback by providing a common visual referent to lead and structure the discussion; enable the embodiment of cues and ideas in a material form that supports conversational practices and cognitive work by extending the capacity of members to store, retrieve, and share mental content; provide a "common reference" for conversations and, by doing so, help bring out potential inconsistencies among members' provisional understandings of relevant concepts and of the emerging relationships among them.

In short, there are plenty of reasons to try physically representing services! We present two techniques you can use even if you have just a day to spare. Taking the time to clarify the key elements and needs for your service initially will certainly pay for itself later in the design process. Better yet, as physical representations can be extremely resource-light, you can utilize them throughout your project.

If you have a day... and want to understand a service: Collaborative physical modeling.

The collaborative physical modeling (CPM) technique means, in essence, having members of the same stakeholder group (such as users or designers) separately build up their understanding of the service in question from playful, tangible materials and then disassemble their built models into service elements and entities in a structured manner. This structured outcome allows for comparison between the understandings of different stakeholder groups.

CPM consists of six distinct steps. To render the differences between stakeholder groups visible, we have used 3–5 participants from one stakeholder group for

one session that lasts 2–3 hours, comparing different groups afterwards. A facilitator is useful to have to ensure the flow and documentation of the process.

1. Preparation: Preparing the setting for CPM means setting up a table and a wall with plain surfaces, chairs, plain paper sheets, and an accessory kit. Recording requires a still camera, audio recorders (and possible video recorders), and note-taking equipment, depending on the degree of detail about the process it is useful to capture. To make sure that all the important aspects of the service are covered, it may be helpful for the facilitator to familiarize himself or herself with the service or field in question.

2. Warm-up: CPM begins with introductions and by explaining the steps of the process. The main purpose of the warm-up is to get people to loosen up and become accustomed to voicing, tangibilizing, and sharing ideas at a quick pace. We have used warm-up exercises where participants have to draw, generate ideas fast (first individually and then collaboratively), and build on each other's ideas[58]. This phase takes roughly 15 minutes.

3. Model building: After the warm-up, the accessory kit is brought to the table and divided evenly in a way that allows all of the participants to reach everything. The participants are then asked to build a model of the concept in question in a physical 3D format using the available materials. The facilitator emphasizes that all solutions are good and artistic beauty is not a target. The participants are encouraged to "get their hands dirty," and the only physical limits are set by the dimensions of the table. The participants are advised to think of an element of the product they want to construct out of the given materials, rather than think about what they could create out of the available materials. In some sessions the participants have written a name for each element, and we have found this worked excellently, but it is not required. Reserve 60 to 90 minutes for modeling. When the model is ready, the participants are asked to briefly present its main elements.

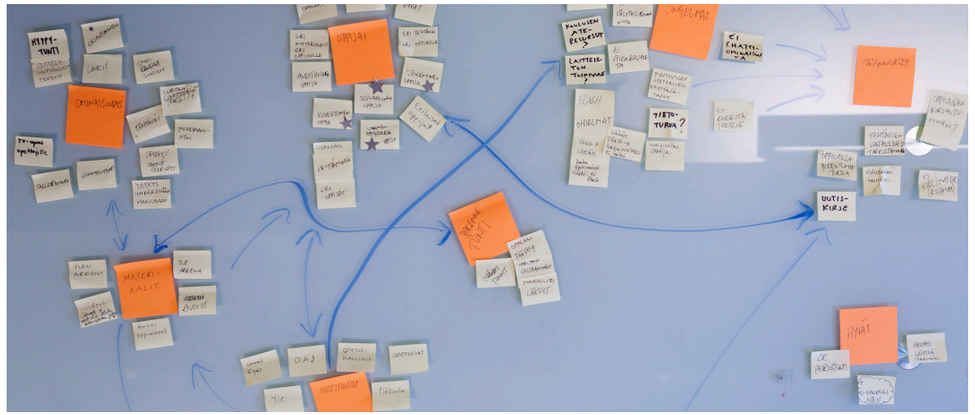
4. Disassembling: The participants are then asked to remove and identify the elements, one by one. One of the participants writes element labels on separate Post-it notes and collects them on another surface in consecutive order. This continues until every element has been labeled and there is nothing left of the model. The elements can be photographed for later use if deemed useful. Disassembling takes approximately 30 minutes, and there may be a need to create new connecting elements when the existing ones are separated.

5. Grouping: The last phase requiring the participants sees them group the Post-it elements on the wall according to affinity to entities and give a name to every entity. The resulting entities represent the main components that the whole product or service consists of (as perceived by the participants). Grouping takes roughly 10 minutes.

6. Analysis: The analysis of the results can take many forms. The quickest way is to visually inspect the grouped elements of a workshop as well as to compare visually grouped elements from different workshops. A more detailed view of comparing workshop results is to list elements and groupings and to systematically pair what can be paired. It is often beneficial to see what commonalities and differences emerge in the representations made by different stakeholders in order to capture core service elements for each stakeholder group and facilitate further collaboration between the groups. The depth of analysis depends on the needs of the project in question, and in-depth analysis is rarely needed as the structured outcomes are easy to comprehend.

Utilizing physical representations in envisioning new solutions and concepts is not unusual. The novelty of CPM lies in analyzing existing services and providing a thorough understanding of the elements a service is comprised of. Thus, when using it separately among different groups, the technique is also able to clearly elaborate the differences in understandings between different stakeholders. However, it can be used for ideation purposes as well. We have utilized CPM workshops in various design contexts, for instance in understanding what an existing online service of the Finnish Broadcasting Company is comprised of from the perspectives of users and designers, envisioning a new concept of the same online service with lead users, and in envisioning what would be the next generation health insurance service provided by a medium-sized Finnish insurance company, from the perspectives of users and designers. In all of our cases, the use of CPM has revealed substantial differences in how different stakeholders understand the same service.

Model building: users' perception of the service in question



Grouping: Users' perception disassembled and grouped

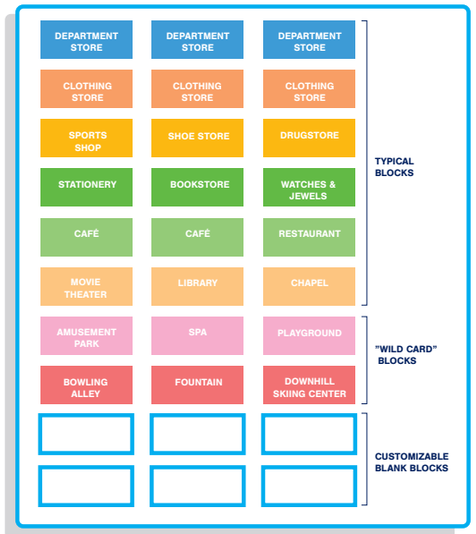
If you have a day... and want users to design solutions: User innovation toolkits

Yet another mean for transferring need-related information between stakeholders arises from user innovation literature[59-61]. These user innovation toolkits may be implemented when information is costly to transfer—that is to say, the information is "sticky"—certain tools, education, or complementary information is needed to gain the information. In the user innovation toolkit approach, users are seen as sources of possible solutions instead of only providing need-related information. For the users to be able to carry out the innovative task, they are equipped with toolkits that they are able to operate with their customary design language and skills. User toolkits help users to explicate their ideas and communicate them in a manner that is understandable to the designers. These toolkits are comprised of materials that are easy for the users to use and a module library—that is, a set of commonly used modules that the user can incorporate into his or her custom design. This will prevent the user from having to "re-invent the wheel." For example, Nestlé developed user innovation toolkits in order to enable chefs making Mexican sauces to create customized recipes that can easily be transferred back to and reproduced in Nestlé's factories. In this way the time required for custom food development was cut from 26 weeks to 3 weeks[59]. Having a module library also ensures that the user information is created in a format that speaks the same language as the developer side.

What the toolkit should look like depends on the product or service that is in question. We have utilized the user innovation toolkits in, for example, shopping center design, with a special focus on the roles of the module library and solutions space. According to the user innovation literature, the solution space must be limited in order to prevent users from developing a solution that the developer side cannot produce[59,61]. On the other hand, it is assumed that

users make use of the offered solution space and that toolkits that offer a large solution space allow substantial innovations[62]. We experimented with different types of toolkits, each used with five women aged 30–40. All of the users utilized the toolkit alone with the facilitator in order to build "the shopping center of her dreams." The puzzle-like toolkits consisted of building blocks made out of polystyrene foam. The use of physical blocks instead of pieces of cardboard, for example, was chosen in order to better support the users in constructing a three-dimensional shopping center. The users were also provided with Post-it notes that they could use for labeling the blank blocks or if they wanted to add a brand name to a certain block. They were first introduced to the method and given a brief written assignment on what to do, and they were also provided with a definition of a shopping center. There was no time pressure, and it took users approximately 10–15 min to complete the task (their custom solution). No facilitation was needed during the building.

We found that supplementing typical modules with more "wild card" examples in the module library encouraged users to create more creative solutions—something that is good to take into consideration when aiming for novelty. While including blank blocks was useful for customization, sets with just the typical blocks and blank blocks did not achieve similar effects on creativity. Including "wilder" options such as spas, fountains, and bowling alleys - in addition to more typical cafes and shops - in the module library encouraged users to be more creative also with the blank blocks. For the first time the designs could be considered personal and the users spoke about "my shopping center".



A toolkit with extended module library and unlimited solution space (i.e. also special and blank blocks included)

An example of a shopping centre design

We are aware that in order to transfer the most detailed picture of the user domain knowledge on shopping centers, the method of choice might be different, being for instance another method altogether, a more complex toolkit, or a combination of the toolkit and some other approach. We deliberately choose the simple puzzle-like user innovation toolkit in order to be able to study the aforementioned relationship and to eventually transfer the learnings back to other design methods and contexts.

Toolkits allow for the user to engage in a trial and error process, but also enhance communication between the users and designers. They excel in transferring sticky and tacit information while also ensuring that it is still possible to produce the desired outcome. The toolkit itself benefits from being easy to use and having a carefully designed module library in the hope of controlling the solution space. A toolkit can take either virtual or physical form, and toolkits can be divided according to the separate sub-tasks of a more complex challenge. With toolkits, different stakeholders can utilize their expertise while drawing on their own lives.

Low-cost alternatives offer a low-threshold starting point

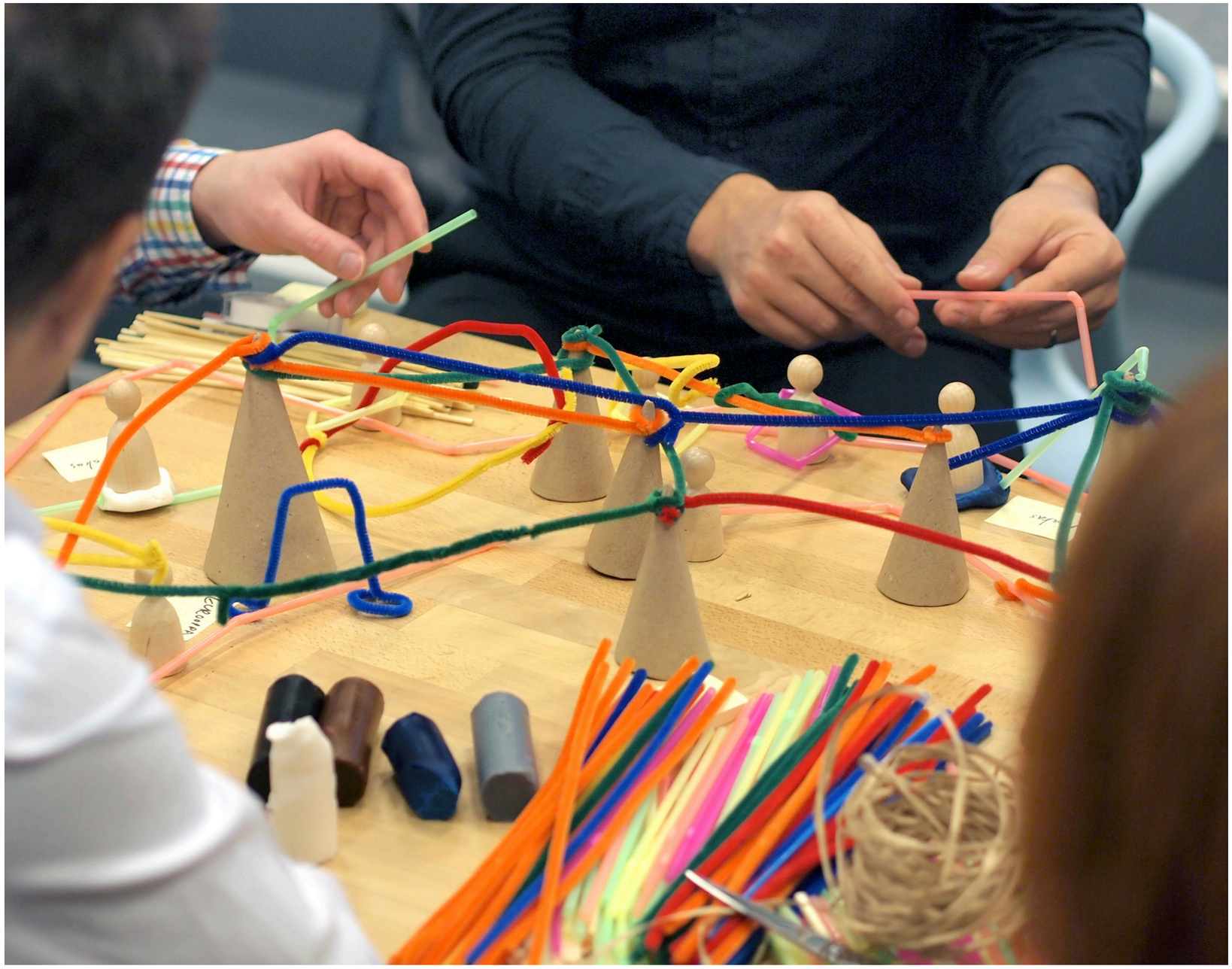
Physical representations can act as a common language among the members of a stakeholder group as well as in transferring service-related understanding between stakeholders. When using CPM to understand an existing service and envisioning new ones, the material nature of the technique—tangibilizing the intangible—seems to have several benefits. Physical models help participants to see connections and to be reminded of elements and prior considerations. This grows even more important when modeling a more complex service or system. The 3D character of the model also facilitates getting at multiple layers of the service as well as at the complex relations it may have to other adjoining systems and practices. Physical representations allow for dealing with complex entities and bringing out relations among them while also extending the capacity to store, retrieve, and organize thoughts and ideas[39,44,57].

Utilizing crafts materials in the modeling appears to be particularly helpful. The fact that each element of the model looks different is good—if we did the same with just sticky notes, keeping track of the whole would require reading through the identical-looking notes over and over again, thus slowing down the process. In addition, the nature of the materials (being common arts and crafts materials that many of us have used as children) also appears to lower the barrier to starting modeling and probably also helps to move away from an "office mentality" that might chain one's imagination and creativity. CPM is able to elaborate the stakeholder understandings of a service in a low-cost, quick, and easy-to-adopt manner and to provide a clearly structured and easy-to-comprehend output.

Similarly, physical, puzzle-like toolkits, as one form of physical representation, can be utilized successfully to support co-creation. In the case of shopping center design, the users found it easy to grab hold of the materials and start building. These three-dimensional mock-ups of ideal concepts for a shopping center, being more perceptible than flat models such as sketches on paper, allowed examination of the physical construction of the concept. Overall, we think the concern for not letting users create anything outside of the solution space (the "producible" space) is relevant when user innovation toolkits are

utilized in the development of products where manufacturing capabilities set clear limits as to what is feasible. In the case of service design, on the other hand, the "producible" space is much wider because the "manufacturing" process is more flexible. Despite being effortless, quick, and inexpensive to produce, the shopping center toolkit was easily able to demonstrate the benefits of physical representations as well as the need for both the solution space and the module library to be opened up in order to ensure that users communicate their individual needs.

In the ever-growing amount of various methods for different design purposes, it becomes more difficult to keep up with all of the possibilities. In real-life projects, there is always a certain limited set of methods, knowledge, and skills to use them, and some suit certain situations better than others. On the other hand, many different methods and approaches share elements with each other. Here the use of physical representations was the shared element, acting as the language amongst and between stakeholders, both in CPM and in user innovation toolkits. The key take away here is that they are simple to adapt and inexpensive, yet the structured manner of producing tangible results is easy to comprehend, process further, and present to others. For managers who struggle with limited resources but are aware of the value of involving various stakeholders, we encourage the use of such low-fidelity approaches before jumping into methods that are resource-intensive and more difficult to adopt. The present day business environment requires companies to be adaptable and agile, thus creating a need for easy-to-adopt and easy-to-modify approaches.



FUELING DEVELOPERS

Fueling developers

Even the best tools will not work in unwilling hands. This section focuses on the motivational heart of co-creation and what individuals can do to stoke the fire. Development and learning frequently require going beyond what is familiar and easy. While pushing beyond our comfort zones tends to be, well, uncomfortable, there should definitely be more passion than pain if we are to expect people to repeatedly wander into these precarious but fruitful grounds. To make sure that co-creation flourishes, people come first in the Design Factories—humane interaction and emanating enthusiasm are perceived as defining characteristics of the platform.[1]

Interest and enjoyment, while certainly helpful, are only a part of the motivational makeup of creativity and innovation. Teresa Amabile's revised framework for creativity highlights the importance of finding meaning and making progress in one's efforts.[2] Perceiving work as meaningful increases intrinsic motivation, while progress helps to maintain continuing efforts towards a creative goal. Both are fundamentally linked to people beyond ourselves. There is a mixture of different types of intrinsic motivational forms at play, varying in their form of connectedness from one to another – such as an other-centered independent mission, setting-dependent passion or other-centered dependent commitment.[3] While it is often not easy, how we incorporate ourselves and others into development efforts can make or break us. Perspective taking—a cognitive process in which we adopt others' viewpoints in an attempt to understand their perceptions, preferences, and actions—helps to create ideas that are not only novel but also valuable and viable.[4]

To fuel the will to co-create and smooth out the worst messiness of people interacting in the co-creation process, this section dives into creating meaningfulness and progress to support motivation. Tua Björklund, one of the founding members of Aalto Design Factory, illuminates how big changes can come from small wins. Rooted in research and examples from startups and organizations who have utilized the Design Factory platform over the years, she makes a case for taking tiny turtle steps to keep track of progress and inviting others to join your efforts, providing early experimentation opportunities to hone initial ideas into viable outcomes. The two subsequent chapters discuss how individuals can better align themselves with team and organizational needs and find personally meaningful roles within co-creation. Satu Rekonen, the developer of the I-like-I-wish facilitated feedback sessions,[5] teases out how to establish the psychological safety and behavioral norms required for teams to be able to capitalize on their diversity. She presents the basics of the facilitated feedback sessions, which have been used by the management and faculty teams of Aalto University, as well as by hundreds of Aalto students. Having an external facilitator in a separate session creates a time and a neutral space for sharing feedback. Another useful form of meaning-making comes from coaching. Christine Thong and Pauliina Mattila from Design Factory Melbourne points out parallels between coaching and tenets in innovative cultures, detailing a variety of ways in which coaching can help in transitioning to co-creation. She also shares some of the tried-and-tested finishing touches from Swinburne University.

All three chapters in this section highlight the importance of feedback—both from others around us and from the effects that our actions have. How to elicit feedback, how to give it, and how to receive it all make a world of a difference in finding the much-needed meaning and progress in innovation efforts. As a whole, these three chapters provide blueprints for the robust human foundation that is needed to adopt and keep using the tools, facilities, and organizational practices described in the other sections of this book.

Two-minute tricks to fuel meaning and progress

While more extensive measures, such as facilitated feedback sessions and coaching, are beneficial in co-creation, there is a world of small and simple things you can do in just a couple of minutes to enhance development sessions. Here are a couple of simple ideas from the professional development workshops conducted at Aalto Design Factory:

Find meaning:
Before going into the topic, help your co-creators identify and share a personally meaningful angle on your topic. We have often set up a bunch of postcards to be used as triggers, asking participants to pick one and share one-by-one why their chosen image reflects, for example, their ideal Design Factory or the most useful product design superpower, depending on the topic of the day. We have found that a little lighthearted humor helps in this, and we like to find images and questions that reflect this. Or you could have everyone write down a goal related to ongoing larger development efforts and share a question they feel would help in achieving this.

Ask for immediate feedback:
Providing small pieces of paper for participants to write down "I like ..." and "I wish ..." comments before taking a break can help you in assessing the pulse of the group and planning your next steps accordingly.

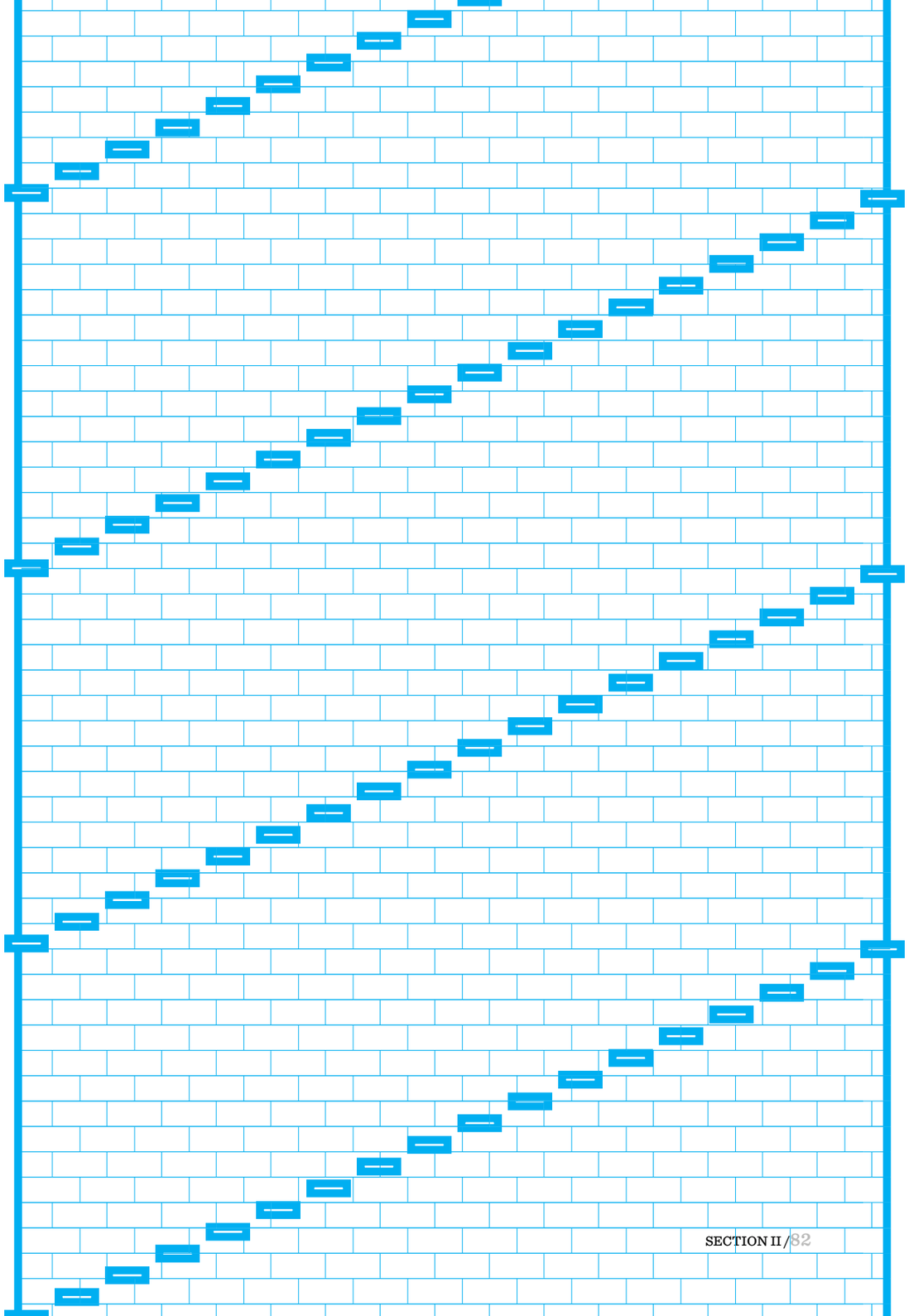
Promote progress:
Many of our workshops end with not only execution plans but also with participants identifying and sharing the most immediate small baby steps they can personally carry out as soon as they return to their desks to advance the cause. We have written these mini-promises on sticky notes, gathered them on a common wall, and applauded as everyone shares their step to take.

SMALL WINS AS FOOTHOLDS FOR CO-CREATION

Tua Björklund

Key points

- Making a series of small bets rather than one large gamble is at the core of experimentation, thereby scaling down what is at stake.
- Small wins mark progress and offer proof-of-concept, opportunities for feedback, and opportunities for joining development efforts.
- Less effortful and more specific behaviors are more likely to be followed through, so making things tangible increases your odds of translating intentions into actions.



Why we should look beyond coming up with great ideas

Many development interventions focus on having more creative ideas in organizations with internal and external idea contests; brainstorming days (often organized as retreats away from the office); training employees on the use of ideation techniques, suggestion boxes, and so forth. The assumption quite often seems to be that in order to amp up innovativeness, we need more and better ideas. However, most ideas do not progress beyond the idea generator's desktop.[1] Popularized by Jeffrey Pfeffer and Bob Sutton from Stanford University, the knowing–doing gap reflects systematic shortcomings in translating new knowledge into action.[2] Overemphasizing initial idea generation can happen at the expense of crucial efforts in idea advancement and implementation that are needed to bring initial ideas to fruition. Intentions to act do not predict actual actions in a straightforward manner, even in relatively short-term simple actions such as voting or using contraception,[3] let alone taking the initiative in complex development projects. All too often development ideas get buried in the midst of daily hurdles. Thus instead of increasing the amount of development ideas to work with, an alternative approach to promoting co-creation can have a larger impact: enhancing the implementation rate of ideas and translating thoughts into experiments in order to see what works rather than speculating about what might happen.

Much of the time spent on planning could have been spent on learning—aiming for small wins means doing small experiments to test our way rather than taking one big leap.

Based on his investigations of technological innovations in the military, MIT professor Donald Schön concluded that ideas either "find champions or die."[4] These informal, emergent leaders actively promote and advance ideas in organizations.[5] However, taking the initiative to push ideas forward drains finite personal resources and can end up being costly for individuals.[6] Faced with the need to develop in a continuous manner, we can no longer rely only on individual champions heroically going against the grain. We need to be mindful of how we can sustain development efforts on a continuous basis—*how* we develop can be just as important as *what* we are developing. Waiting around for breakthroughs can be demotivating. Rather than preparing for a big battle, a steady stream of initial small advances can sustain the motivation to continue developing.

Small wins are immediate, tangible, and controllable steps that can be tackled to advance ideas[7] They are experiments producing small but visible results, such as a positive customer testimonial, setting up a task force, or gaining permission for a new hire, to name a few possibilities. Development strategies focused around small wins rely on identifying "a series of controllable opportunities of modest size that produce visible results,"[8] or concrete actions taken to discover, test, and develop ideas that are both achievable and affordable.[9] Different kinds of small-scale experiments are created to test and demonstrate the viability of development ideas, rather than planning the whole concept and execution process in advance. Acting in uncertain environments cannot rely on centralized comprehensive planning and foresight.[10] The initial experiments provide more information to base our decisions on. Rather than thinking in terms of making mistakes or failing experiments, we learn from variations. Aiming for small wins scales down what is at stake by making a series of small bets rather than one big one.[9,11] Furthermore, this approach can help to decrease the knowing–doing gap, as Pfeffer and Sutton propose that knowledge gained from action is more likely to be implemented than knowledge gained through contemplation or discussion.[2] Small wins get the ball rolling, and increase the odds for further development action.

The psychology of small wins

Studying 12,000 diary entries of professional developers, Teresa Amabile and Steven Kramer found that perceived progress is the single most influential factor in day-to-day development motivation.[12] By creating, sharing, and testing a series of prototypes, development efforts are made tangible and visible in the environment. Small wins are a large reason why experimentation works so well. They specify the opportunity and solution, encourage feedback, and help to track progress. Seeing that our efforts are bearing fruit is a key component in most motivation theories, whether coined as impact, progress, or mastering a task.[13]

Visible development efforts can also prime for further development. Priming is a subconscious process through which the people, artifacts, and concepts that we are exposed to in our environment have subtle influences on us, making some thoughts and behavior more likely than others.[14] For example, being primed with a disapproving department chair leads to less favorable self-ratings of one's research ideas,[15] being primed with nurses leads to participants more readily helping others,[16] and being primed with creative stereotypes (such as Apple logos) can boost creativity in idea generation.[17] In a sense, whatever is in our environment is contagious—in a "chameleon effect," we subconsciously mimic the people around us,[18] adapting similar postures, expressions, and mannerisms in order to facilitate smooth interaction. While these influences are small, they are significant. It makes sense to make our environment work for us, rather than against us, in our development efforts.

We can tweak our environment to our advantage, helping to trigger the types of developm ent actions we want to pursue. In other words, development breeds further development.

Already the act of making prototypes can enhance one's understanding of the development idea, context, and challenges specifying what is at hand.[19] Furthermore, small wins carry several motivational benefits that can help in turning aspirations into action. Entrepreneurship research has found two key types of antecedents influencing intention-to-pursue opportunities: those affecting the perceived ***desirability*** of the opportunity and those affecting the perceived ***feasibility*** of the pursuit.[20] In general, motivation theories usually take into consideration both the desirability of a goal and one's perceived chances of reaching the goal when assessing the likelihood

of taking action.[21] Small wins can enhance both of these antecedents by eliciting feedback, recognizing results, and lowering the threshold for action.

Positive feedback energizes. Development ideas are rarely pursued if they are not somehow personally valuable to the developer.[22] However, ***maintaining*** idea advancement efforts is largely dependent on perceptions of how ***others*** value the idea.[22] Making efforts more tangible creates more opportunities to gain feedback. Positive reactions from key individuals can have lasting impacts: Aalto Entrepreneurship Society founders perceived positive comments from the Aalto University board and management as a mandate to proceed with their ideas. On the other hand, feedback through weaker ties can also play a significant role in maintaining development efforts. In our studies of start-up companies creating their first offering at Aalto Design Factory premises, we have found that many entrepreneurs approach their firms with renewed energy after receiving positive reactions to their ideas in events such as fairs. Such serendipitous encounters, made possible by making a development tangible, offer affirmation of the pursued direction.

Progress maintains commitment. Positive feedback not only increases perceptions of desirability but makes development seem more feasible. Prototyping makes development more tangible, and action becomes more likely as the what and when of things are specified.[23] Without looking for small wins, we can easily feel like we are running towards an ever-changing goal, never reaching our target. One start-up, for example, kept delaying an in-office celebration one step later—from the first mock-up, to the first client, to the first profit—with detrimental effects on the team's energy levels. It is good to stay hungry, but failing to notice progress can end up gnawing at motivation. Breakthroughs are, by definition, rare—keeping track of smaller wins helps to check whether you are still on course.

Smalls wins lower the bar. Organizations are increasingly calling for employees to be proactive on all fronts, rather than just excelling in their own role. Knowing that time is limited, starting can sometimes be the hardest part. Especially when you are developing something outside of your primary task or project, efforts can often stall and wither away quietly. To scale down the required effort, try thinking about ***the least*** you can do. For example, rather than putting off cleaning the entire house indefinitely, you can set out to do a series of five-minute makeovers. What would be your organizational equivalent? Choosing a small task will make it more likely that you eventually get to your goal. Christine Carter from the University of California, Berkeley advocates identifying ridiculously easy "turtle steps" to help build new habits.[24] Almost half of our daily actions are done out of habit rather than based on actual decisions,[25] so it makes sense to make development a routine part of your workday. Setting the bar low enough minimizes the excuses you can come up with to avoid acting towards achieving your goal. Identifying clear action triggers[26] when you will take the turtle steps to advance your ideas further increases the likelihood you will actually do so. Identifying the first turtle step beforehand can be particularly valuable when returning from an off-site company retreat, inspirational talk, or development workshop in order to ease the transfer of your good intentions from a separate development-intensive event into your normal organizational life.

HOW SMALL WINS HELP TO TURN DEVELOPMENT INTENTIONS INTO ACTION

Benefits for the developer:	Benefits for potential allies:	Benefits for potential hostiles:
Making a habit of development	Making ideas visible	Getting used to the idea
Gaining feedback	Providing immediate small-scale opportunities to join development efforts	Scaling down the needed change
Marking progress		Proof-of-concept

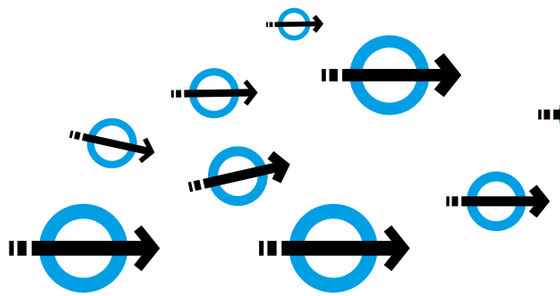
Small wins help to get others on board

Nowadays development efforts are hardly ever a solitary pursuit. Involving colleagues, management, clients, and other stakeholders in your efforts can be crucial for successful development in the long run.[22,27,28] In addition to providing motivational benefits for the initiator of the development efforts, small wins can also help to attract allies and deter opponents to your cause. Three key mechanisms are in operation to make development more palatable: small wins can minimize the required change at any given time, they demonstrate effectiveness, and they make efforts timely.

Downplaying change. The strategy of pursuing small development wins is compatible with the classic foot-in-the-door sales technique.[29] Approaching one small win at a time scales down the scope of the challenge, making it easier for people to say yes and harder for them to say no. Looking at 82 instances of managers selling issues ranging from creating an in-house mini-laundry to updating departmental practices, Jane Dutton and colleagues found that all successful (yet only few unsuccessful) attempts had presented change incrementally rather than as a totally new path to pursue.[28] Acclimatizing key decision makers well before the need to decide arises and highlighting the compatibility of suggestions with current operations and goals have been identified as common tactics in successful idea selling.[28] In other words, successful idea selling or championing involves processes by which individuals affect others' attention and understanding of developments in the organization.[31]

Building a track record. Generating a series of small wins also serves as proof-of-concept to skeptics, legitimizing change.[11] Issue selling is easier when you have supporting evidence at hand, such as numbers and concrete examples gained from initial efforts.[30] Not only does initial success appease potential hostiles, it increases the perceived feasibility of your efforts in the eyes of potential collaborators. Demonstrating an action-orientation and achieving results at a quick pace was perceived as the most crucial success factor enabling the swift development of the Aalto Entrepreneurship Society, building momentum and attracting further input.[31]

No waiting period required. Finally, reaching for small wins can create immediate small-scale opportunities for joining in with or supporting development efforts. Many projects struggle in turning goodwill into actual contributions. Concretizations, even if quick approximations of the actual idea, provide tangible opportunities to join in the process of making, as well as to comment and give advice, compared to mere plans of action. Seemingly serendipitous events and "lucky breaks" are often based on groundwork building opportunities for collaboration and the propensity to act.[31,32] Eliminating the waiting period between introducing a promising idea and the opportunity to do something about it can lower the threshold for initial input and strengthen subsequent commitment. Involving others in the project may take some time but it is needed for eventual effectiveness.[28,22]



Actions and events are vectors rather than points in time: Each influences subsequent ones, making some options easier and more likely to be followed than others

Using small wins to pace yourself for the long run

As development becomes a constant need in organizations, attaining spectacular results once is not enough. We are running co-creation marathons instead of a single make-or-break sprint. As a result, we need to take care of our development energy levels and make our efforts sustainable in the long haul. Adopting a strategy of small wins achieves this by breaking down development into smaller, visible, more palatable pieces, both in human and economic terms. Development ideas can be tested on a smaller scale, in parallel or sequentially, in order to gain the experience needed to make it work. For example, the Teaching Partner pedagogical development process in Aalto University, described by Maria Clavert in Section IV of this book, often starts with changing a single teaching session and gathering feedback on it, only gradually moving on to more comprehensive overhauls. Developing something new often means we do not know what will happen in practice—we can avoid overcommitting ourselves by first getting the feedback we need to hone our ideas.

Small wins also help to build a support base amongst stakeholders. For example, changes to the high-technology product of a large company advanced almost through a smuggling process. A product developer used client contacts to build external pressure for change, leading to the creation of a local adaptation of the product on the client site to satisfy client expectations. After positive experiences with this single site, the changes were rolled out on a wider scale to the product line.

The classic Zappos.com example illustrates that you do not need to set up an entire organization in order to test whether people would be willing to order shoes online: instead the founder walked into a local shop, took pictures of the shoes on sale and posted them online. When the first orders were made, the founder then bought the shoes from the store and delivered them to the customers.[33] Testing development ideas in such an incremental manner ensures that we do not fall far if our step is misguided. There is no need to dust ourselves off, rather we can incorporate what we have learned in a stride.

So the next time you are drafting a battle plan for your development idea, remember to.

Clarify your idea by making it more concrete, for example, in a sketch or prototype

Think about what is the least you can do to make some initial progress

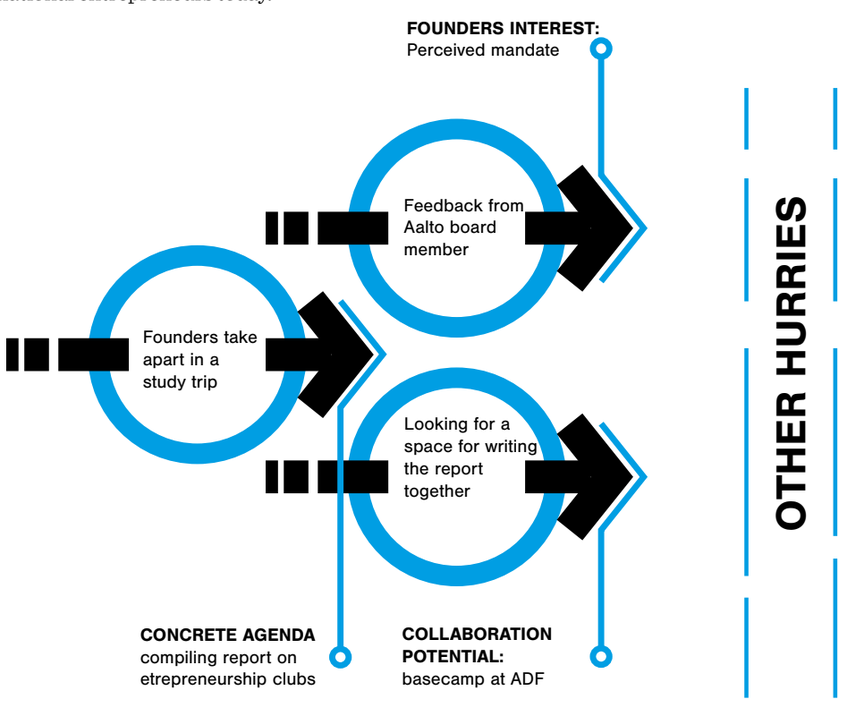
Do it, and tell a friend—celebrate each small win

Repeat: keep on testing and refining the idea and seeking some easy wins along the process in order to attract allies, deter opponents and keep yourself motivated

Aalto Entrepreneurship Society: Gaining momentum through small wins

Aalto Entrepreneurship Society (Aaltoes) is a student-based society promoting growth entrepreneurship. Born during the formation merger of Aalto University, the idea of three students transformed into an organization with 5,000 members within a year that plays a role in university strategy as well as the development of the national entrepreneurial ecosystem. Startup Sauna, Startup Life, Summer of Startups, SLUSH ... Aaltoes actions can be thanked for a number of support formats offered for budding Finnish and international entrepreneurs today.

The founders credit their culture of action for the success. By concretizing action and making progress visible, Aaltoes was able to fuel the precarious initial development steps by small wins right from the beginning.[31] The concretization in the form of a specific agenda, a Facebook page, a planning session, and an initial event made outside interest visible and laid the groundwork for future collaboration:



UNLOCKING THE POTENTIAL OF INTERDISCIPLINARY TEAMS

Satu Rekonen

Key points

- Interdisciplinary teamwork in innovative projects poses various types of challenges for the team. In addition to the variety in team members' skills, knowledge, and ways of working, project- and people-related uncertainty and ambiguity are present in many forms.
- Making the most out of an interdisciplinary team and being able to proceed with a project characterized with ambiguity and ill-defined problems requires courageous behavior.
- The demanding nature of work in interdisciplinary innovative projects calls for people skills that enable rich and efficient communication and indicate emotional intelligence.
- In order to make the most out of the interdisciplinary team, practices supporting open communication and a trustful atmosphere need to be built early on.

Much of the work we conduct, especially in innovation, essentially takes the form of a project. Even if we are not involved in an explicitly formalized project, our work still often has the essential qualities of a project, such as a set duration and a team that comes together temporarily for a period of time. Also, the focus is shifting from multidisciplinary work, where each collaborator preserves his or her field of expertise and ways of working, to a more interdisciplinary collaboration, where team members from different disciplines approach a problem or solution in an integrated manner. Having been immersed in this complexity through researching and facilitating the work of interdisciplinary innovation teams, including dozens of feedback sessions and interviews, I attempt to flesh out some of the issues I have found to be important in enabling a team to work efficiently and successfully towards its goal.

The gains and pains of interdisciplinary teamwork

It should not be a surprise to anyone that having multiple disciplines represented in a development team provides value through a variety in perspectives and approaches along with a broader array of expertise, skills, and knowledge.[1] Through this variety a wider range of possible solutions to the problem at hand can be achieved,[1] which can lead to highly successful and disruptive innovations and creative outputs.[2] There are countless examples through the known history of innovations where combinations of different bodies of knowledge have been at the core of novel and valuable outcomes. Cognitive diversity in terms of knowledge and skills also means broader access to information and knowledge.[3] When an individual has contact with a diverse group of people, the likelihood for obtaining knowledge about different approaches to the problem at hand is greatly increased. Functionally diverse teams also offer greater access to different types of information not only through the self-contained information of team members' functional background but also from diverse external personal networks.[4] Communicating with others in the field enhances the understanding of the area and facilitates the generation of approaches that are feasible, appropriate, and unique.[5]

However, things are not so simple and diversity does not only have positive consequences. *Bringing together people with different backgrounds who chase different aims, possess different skills and capabilities, and use different working styles guarantees challenging circumstances for teamwork.* Interdisciplinary teams often experience a clash of views, interests, goals, and values as different disciplines have their own culture, a domain-specific language, along with discipline-specific practices and ways of working, among others factors.[6] For example, when developing a new product, aesthetics, shape, and emotional impact might be the drivers in the decision process for industrial designers, while engineers pay more attention to such things as function, cost, and complexity.[7] Cagan and Vogel[7] illustrate the difference between engineers and designers by noting that, while engineers are trained to think in terms of what is "right," designers, on the other hand, are trained to explore and think in terms of what should or could be, not what is.

While team member diversity brings a variety of viewpoints and allows the consideration of a wider range of perspectives, it does not, however, ensure this. If these team processes are not well understood and properly managed, the differences in skills and knowledge may lead to significant interaction difficulties among team members.[1] The differing viewpoints that are essential in promoting creative new ideas and in making well-informed decisions are also possible sources of conflict that waste the team's time and cause interpersonal challenges and frustration[4] Task conflict, meaning differences in members' viewpoints regarding their tasks and activities,[1] can create problems if the differences in opinion block the progress of the team or if they turn into person-related issues.[8] Considerably differing perspectives—or disagreements—may turn into more emotion-based reactions.[9] The ability to keep disagreements task-related and not let them turn into emotional conflict is key. This requires that the team is capable of collaborative communication and that there is a supportive atmosphere within the team.

Team member diversity can also have an effect on the initial degree of satisfaction within the team since members may not identify as strongly with a team consisting of people perceived as different as they would with a team of similar others.[2] Team members who hold the same perspectives may be easily drawn to each other, which may lead to the segmentation of the team. By drawing boundaries within the team, the development of trust is blocked which can again lead to a more frustrating team experience. A lack of team identification, emotional conflict, or the absence of psychological safety (i.e., the absence of a shared belief that the team is safe environment in which to speak up without the fear of negative judgment[10]) may also make members less willing to contribute their ideas and knowledge to the team.[2] In order to benefit from the diversity of knowledge, experience, and perspectives, team members need to recognize the need for both their own and other's input to good performance in order to understand the contribution of dissimilar others and, furthermore, to be able to integrate these contributions in a valuable manner.[11] On top of this, motivational aspects play an important role: *unless team members recognize their inputs as indispensable and valuable, they may have the tendency to free-ride or think their contribution is irrelevant.*[12] This is likely to lead to a situation where the full potential of the diverse team is left unutilized.

Ambiguity, uncertainty, and the need for courage

To come up with novel and innovative solutions, interdisciplinary teams must be ready to face ambiguity and uncertainty, which are present in different forms along the span of a project.[13] First of all, teams are working with challenges that are often "wicked"; ill-defined and characterized with a high level of complexity and uncertainty about the "correct" solution to the problem at hand.[14] Often the situation in innovative projects is that neither the goal nor the means of reaching the goal are known at the outset.[15] In order for the team to move forward in the uncertain terrain it needs to take action despite the discomfort of uncertainty and high risk of failure.[16] This means that the team needs to create the necessary information and learning along the way through iterative prototyping, modeling, and simulation that explore different alternatives.[17] In addition, help seeking[18] and expressing one's point of view[10] are needed. All these actions also expose team members to personal risk, for example the risk of appearing incompetent or disagreeable.[19]

Interdisciplinary teams are assembled to pool diverse expertise. To solve complex challenges, we want to have people in the team who bring their different knowledge and perspectives to the table. This means that the starting point in interdisciplinary teamwork is information asymmetry, which means that team members have distinct, unshared information. For the team to be able to benefit from the diverse set of skills and capabilities, it is important that team members freely and willingly share their unique information and perspectives. How-

ever, this privately held information does not get automatically shared with other team members as teams have a tendency to focus their discussion on information that is commonly possessed in the team.[20] When it comes to innovative projects where the interdisciplinary team needs to be able to solve complex and ill-defined problems, the integration of each member's information and expertise is key. Individuals may at times falsely assume that certain knowledge is commonly known and be unaware of others lacking some of the knowledge they have. Often these insights that come from deep understanding of one's discipline and seem so obvious that explaining their reasoning may not occur to them, are also the ones that create misunderstanding and conflict. People also fear exposing their ignorance in front of experts from a different discipline, which may lead to a situation where "stupid" questions are never asked and that privately held information is never shared.[21] What is obvious to, for example, designers may be entirely unfamiliar to those with a business background, which is why reasonable questions may come across as ignorant.

As the solution space in innovative projects is usually vast and there is rarely only a single possible solution, multiple alternative solutions need to be generated, analyzed, and decided upon in an iterative process.[6] The process of innovation is a rhythm of search and selection, exploration and synthesis, cycles of divergent thinking followed by convergence.[22] The two fundamental types of activities—widening the problem or solution space (i.e., divergent thinking) and narrowing down (i.e., convergent thinking)—require the team to adopt different approaches and mind-sets in their teamwork and communication. In a divergent phase, the team needs to take different perspectives and be able to openly communicate their ideas and utilize their variety of knowledge and capabilities. On the other hand, as the team needs to narrow down the problem or solution spaces the team needs to evaluate make selection between possible alternatives to proceed with. Here, it is important that the different perspectives from different disciplines are considered and that team members are able to explain and rationalize their point of view. *The quality of both the divergent and convergent activities depends on how openly and freely the team members share their unique (background-related) information and bring up their points of view*. In both types of activities, the ability to communicate one's views and ideas and, on the other hand, the will to understand and respect others' perspectives are crucial. The more information the team has available to build on, the more likely it is to come up with a novel and valuable solution.

Additionally, the changing needs of innovative projects require team members to adapt to varying requirements.[23] This means that the role of team members rarely remains the same throughout all the phases of the project. Rather, rethinking and reflecting on one's role is required as the project proceeds. For example, the early phases of the project where the nature of work is more explorative requires different kind of approaches compared to the later phases, which are usually more structured and goal-oriented.[24] Naturally, some team members have strengths in the early phase activities while others have strengths in the later ones. Finding one's role in a complex interdisciplinary innovative project may not be easy and the longer it takes, the more difficult it might get.[23] In addition to finding an appropriate role, team members often come to feel uncertainty regarding to the role they have taken.[25] A team member in a semester-long student design project described his feelings as follows:

At times I've been worrying about my own input in the sense that I wonder if I am being crazy and creative enough because I wonder if that's what they really expect from me since I am the designer. Sometimes I doubt whether I am fulfilling the expectations I am supposed to.

This role-related uncertainty may impede people from utilizing their unique skills and knowledge in the project. As team members represent different disciplines, they should be able to act as an expert of their field and courageously bring their points of view and skills to the table. Also, as team members usually do not have extensive knowledge of all the other disciplines, it is the duty of each member to make their skills and knowledge explicit to others. Innovative interdisciplinary projects require utilizing skills that are not required in projects with people from similar functional backgrounds. One needs to be able to present one's point of view clearly to others and dare to disagree in order to ensure that all aspects are being taken into account. When taking into account the circumstances that team members are dealing with, it is undeniable that working in interdisciplinary innovative projects requires courage in many forms. One could say that interdisciplinary innovative projects force you to get out of your comfort zone. However, the fear of failure or appearing incompetent to others may impede the participation of team members. Brené Brown, a research professor at Houston Graduate College and the author of the best-selling book Daring Greatly, describes vulnerability as being the birthplace for creativity, innovation, and change.[26] She defines vulnerability as emotional risk, exposure, and uncertainty, and as something that is often seen as a weakness in ourselves but as courage in others. The key question then becomes how to create an environment where people feel safe to feel vulnerable and uncertain, and courageously take the needed action despite their uncertainty.

The key challenges of interdisciplinary teamwork in innovative projects

- Dealing with a variety of skills, knowledge, and ways of working
- Going through phases that are very different in nature
- Facing ambiguity and uncertainty in different forms
- Taking action despite the discomfort of uncertainty and high risk of failure
- Confidently bringing one's expertise and capabilities to the project
- Utilizing skills that may not have been needed in previous projects

The cornerstones of utilizing the potential of an interdisciplinary team

Taking into account the challenging circumstances one must deal with when working in interdisciplinary innovative projects, surprisingly little attention is typically paid to soft skills. Teams are typically busy pushing the project forward, which places the focus on the more concrete aspects such as building prototypes and ensuring the project is on schedule. The more intangible aspects—such as taking the time to consider how the team is doing as a team, or sharing and hearing how everyone is feeling about the project and their roles in it—are often neglected.[25] After all, it is the soft skills, or people skills, that facilitate the utilization of the range of expertise within the team. Soft skills support teamwork by enabling efficient communication and understanding the feelings team members go through in different phases of the project.[27] For example, shedding the uncertainty related to team members' roles in the project is likely to be more effective when emphasis is put on sharing and understanding the perspectives and feelings of the individual team members rather than focusing on formalized task allocation and role specification.23 The better the team members understand (or are willing to understand) the differing points of view of others and the contributions of dissimilar others, the better the chances of making the best out of the diverse team. Based on my research and experience, successfully harnessing the power of an interdisciplinary team is dependent on four foundational constituents: 1) an awareness of the knowledge and skills within the team, 2) an enabling atmosphere, 3) shared ways of working, and 4) constructive feedback.

Being aware of the spectrum of skills, knowledge, and expertise in your team

Often the first obstacle in utilizing the knowledge and skills in an interdisciplinary team is simply not being aware of them. Especially in newly formed teams, the team members are not well aware of the knowledge and skills the other team members have. In innovative projects, it is not only the professional skills accumulated through education or working life that matter. When there is no single correct answer for the problem to be solved, "thinking outside the box" is needed and the whole range of experiences gathered during one's life is potentially useful in providing valuable insight to the problem at hand. This is why it is important to make time for the team to get to know each other and each other's backgrounds well enough. The better and sooner team members know each other's history, experiences, and capabilities, the easier it is to utilize those throughout the project. It is the responsibility of each individual to bring their expertise to the table, as others coming from other disciplines and backgrounds cannot be well aware of it. However, telling others what one's skills are and what value one can bring to the project might feel difficult, especially if team members do not know each other from before. Convincing others of the value one can bring to the project gets increasingly difficult as the project proceeds, which may lead to detached team members or "free riders." Hence, providing time early on for the team to get to know each other is essential.

Questions to discuss and reflect on within the team:

• Consider your life: what have been its meaningful moments or turning points? What have you learned and gained from these?

• How have the different time periods and experiences in your life affected the development of your professional skills?

• How have they built up your personal strengths and other capabilities?

Building an atmosphere that enables stepping out of one's comfort zone

As the value of interdisciplinarity lies in the variety of perspectives, skills, and knowledge, they not only need to be acknowledged but also to be put into use. Having a supportive environment where team members are willing to share their points of view is the second essential condition for this. Putting in the effort at the start of a project to create a supportive and appreciative atmosphere is vital. My research has indicated that teams that spend more time at the beginning of the project getting to know each other and creating a feeling of togetherness (often in an informal manner) were less affected by setbacks taking place in the later phases of the project. You could say that the foundation for solid teamwork is built during the first steps of the project. Establishing a supportive environment does not necessarily require significant effort. It also develops through small acts: words of encouragement and appreciation, asking others for opinions and showing interest towards them. What I have come to notice is that positive experiences are important, especially early on in the project, as the initial reactions of others can have a long-term encouraging or discouraging impact on the willingness to share one's point of view. For example, if a shy person feels that her or his opinion was not taken into account in the first place, she or he is unlikely to feel very confident about sharing her or his views again later on.

Questions to discuss and reflect on within the team:

• What are your hopes and fears regarding the project?

• When are you at your best when working in a team? For example, what kind of support do you need from your teammates in different situations?

• What does being supportive and appreciative mean to you on a concrete level? How do you yourself act when you are being supportive and appreciative?

Creating common ways of working and behavioral norms

Behavioral norms (i.e., the expected ways of behaving and the level of quality when working in a team) are created early on during a project.[28] Project leaders and teams that accept flimsy excuses for substandard performance—such as not completing tasks on time, defensive shrinking of responsibility and people arriving late—create a reputation and an acceptance of mediocre outcomes. Usually it is the things that might seem self-evident or not worth considering that are most easily neglected during the project and cause the most frustration in the interaction between the team members. Such things as how often the team meets, what the team's channels for

communication are, and how many hours the team expects everyone to put into the project on a weekly basis (or how much people are able to put in the project) should all be considered with the team at the beginning of the project. The better the practices reflecting the desired ways of working in the team are established at the beginning of the project, the better they stick and serve throughout the project. For example, even if a pronounced need for open communication is already recognized during the early steps of the project, it probably never becomes a natural, well-rooted way of working in the team if there are no established practices that aim to support this purpose.[25] It is possible to build the kind of culture desired within team, but acting according to what has been agreed upon usually requires some reminding. On the other hand, maintaining and strengthening the ways of working and behavioral norms agreed upon within the team is only possible when the team members are aware of them in the first place.

Questions and points to discuss and reflect on within the team:

• What do you find most important when working together as a team?

• Take a moment to consider your previous experience on working in a team: What has worked well? What has not worked?

• Create three guidelines/values that your team agrees to follow. Provide concrete examples of actions where acting according to these values is realized.

Providing positive and constructive feedback systematically

As established in the previous chapters, the need for open and constructive communication is highlighted in interdisciplinary teamwork. If we consider the building blocks of creating a supportive atmosphere it all comes down to how we interact and communicate with each other. Communication is in many ways the foundation of success in projects but also one of the most challenging aspects. As noted by Edmondson and Nembhard,[4] team member diversity should foster creative tensions and disagreements that are mediated through collaborative communication and exploration, which will again result in more innovative outcomes. If these creative tensions and disagreements are avoided, the risk is that deeper exploration—and thus potential novel solutions—might be left unseen and the value of interdisciplinary teamwork remain unutilized. Accordingly, the limited participation of any team member means that valuable information and inquiries are lost and that unproductive communication can hinder learning and innovation.[4] This again highlights the need for establishing structures supporting open communication among team members, which is especially important in interdisciplinary teams where differing and competing viewpoints are essential in promoting creative new ideas as well as being possible sparks to ignite conflicts that waste the team's time and cause interpersonal challenges.

There are a number of reasons why providing both positive and constructive feedback should be well established as a way of working in an interdisciplinary team. First of all, when there is an open and trustful atmosphere, it is easier for people to act courageously and also to be vulnerable, in other words, to engage in activities that involve, for example, a risk of showing them to be incompetent. In innovative projects, it is difficult to avoid this since they call for individual and collective creativity, which requires team members to feel safe to share their ideas, thoughts, and doubts related to the project. In the end, the level of participation in a team depends on how freely people feel they can share their unique information or bring up their own perspectives among the team. Second, it seems that when people receive positive feedback on their work they become more confident to give their all for the project. Further, others may recognize strengths or potential in us that we are not able to see ourselves. We may become blind to our strengths and others might be better at recognizing them in us. This is especially important in creative projects where one needs to utilize different kind of skills and capabilities. Finally, interpersonal challenges are often sparked by never explicitly addressing misunderstandings or single occasions where someone felt assaulted. These experiences easily build up into beliefs and assumptions about how we see others or how they see us. The risk is that these assumptions are never explicitly brought up, which might lead to energy being wasted on issues that never existed in the first place. Assumptions may be person-related (what I think about others, what they think about me) or task-related (Am I doing the right things or doing things right?).

Facilitated team feedback—the "I like, I wish" method

I like, I wish (http://ilikeiwish.org/) is a facilitated team feedback method in which team members provide and receive both positive and constructive feedback on both individual and team levels. The sessions follow a systematic format promoting psychological safety that has been developed through dozens of sessions organized for interdisciplinary teams since 2011. These feedback sessions offer support for the internal communication of interdisciplinary teams working with challenging and innovative projects with the main purpose of increasing the feeling of togetherness and forcing the team to take the time to reflect on everyone's role in the project and how they are bonding together as a team.

The roots of this method sprang from the period from 2008 to 2009 when I was part of an interdisciplinary and international team in a master's level product development project course at Aalto University. During that time, I was studying in business school and the whole world of rapid prototyping and thinking-by-doing was something very new to me. It was difficult for me to find my role in the project and I felt a desperate need to understand what my team members saw as my role, strengths, and potential contribution to be in the project. But as we were busy with pushing the project f0rward and I was unsure as to whether anyone else felt this could be useful, I never spoke about my thoughts out loud. However, it turned out that when I later conducted interview studies in two master's level product development courses, the interviewees frequently expressed very similar thoughts and feelings. The majority of the interviewees described a need for receiving feedback regarding one's role and contributions in the project. Since then I have witnessed this need and the benefits of a systematic method in dozens of feedback sessions on several different interdisciplinary student courses as well as in professional teams. I am constantly amazed to see the effect these sessions have within the teams; how the shared understanding and the feeling of togetherness among the team increases, how the individuals in the team become more confident as they come to realize

the strengths and the value the others see in them. I have come to recognize the centrality and necessity of constructive feedback in interdisciplinary teams. Many of the self-doubts team members have about themselves and the assumptions they make about what the others in the team are thinking frequently prove to exist only in the team member's mind. Typically, all that is required to get rid of these disturbing issues is to take the time and speak them out loud in a safe setting.

I like, I wish in a nutshell:

• The method is based on having a facilitator who is not a member of the team. In this way she or he is able to create a neutral setting. The main role of the facilitator is to provide a framework where it is safe and easy for the team to openly give feedback to one another. A safe and trustful atmosphere is critical and the facilitator has a big role in establishing this.

• The method consists of three parts: writing down feedback individually, sharing the feedback, and reflecting on the feedback. Feedback will be only be written and provided to the team members that are present in the session.

• Team members will be sharing (and receiving) both positive and constructive individual- and team-level feedback. Positive feedback ("I like ...") refers to the strengths seen in a team member / team whereas constructive feedback ("I wish ...") is about the potential seen in a team member / team that has not yet been fully utilized during the project.

• Sharing the feedback starts from individual-level positive feedback and everyone will share their "I likes" with the one person at a time. It is important that the "I like" round will not be interrupted at any time. The person receiving the feedback can share his or her feelings and thoughts after the round.

• After everyone has shared their "I likes" with everyone, the team will move on to sharing individual-level "I wishes" in a similar manner, then to team-level "I wishes," and finally to team-level "I likes."

• It is important to reserve time at the end of the session to give everyone an opportunity to share their feelings regarding the session as well as to give time to reflect on the feedback shared.

• The detailed instructions for facilitating an I like, I wish team feedback session can be found at the webpage http://ilikeiwish.org.

Checklist for capitalizing on the potential of an interdisciplinary team!

1. ***Be aware of the full range of capabilities within the team and make sure to utilize them***

Why? The value of a diverse team is in its heightened ability to solve complex tasks through the broad array of expertise, skills, and knowledge but only when it is being properly utilized. The skills that others can bring to the project may not only be related to their educational backgrounds but also to their life experiences, passions, and hobbies.

2. Make your skills, knowledge, and experience explicit early on in the project

Why? Only in this way is the team able to utilize the expertise and knowledge. The further the project proceeds, the more difficult it is to change the perceptions others have and promote your skills to others.

3. Create common ways of working and team culture at the very beginning of the project

Why? Practices built early on stick and serve throughout the project. However, these mutually agreed practices need to be cultivated along the project.

4. Remember to give both positive and constructive feedback to your team members

Why? Without feedback people do not know if they are doing things right and/or doing the right things. Positive feedback also increases the confidence and strengthens the motivation of individuals.

5. Be open to everyone's ideas—whether they are feasible, crazy, funny, or seemingly impossible—without judging them immediately

Why? The level of participation in the divergent and convergent activities depends on how freely people can share their unique knowledge and bring up their own perspectives within the team.

6. Make sure that the atmosphere within the team is appreciative, encouraging, and supportive

Why? People feel more confident to open up and freely share their thoughts in such an atmosphere. Establishing this kind of an atmosphere comes from small things: words of encouragement and appreciation, and acts of help.

7. Make it more than just about work

Why? Teams that spend more time at the beginning of the project getting to know the team members and interacting informally are likely to be less affected by the setbacks that occur in the later phases of the project. Organizing informal gatherings with your team might help to keep the feel of togetherness, even through tough times.

COACHING FOR AN INNOVATION CULTURE

Christine Thong
Pauliina Mattila

Key points

- Our world is constantly changing, and navigating increasingly complex human and technological systems requires collective team capability rather than individuals responding in innovative ways.
- Coaching is an effective technique for empowering people to behave in the ways innovation requires, such as taking risks, engaging in creative problem solving, acting with a low hierarchy, and working outside comfort zones.
- The focus of many styles of coaching is on goals that are aspirational and behavioral in nature, making coaching a perfect tool to re-enforce cultural norms related to innovation.
- Dedicating resources to coaching teams and individuals, as well as using coaching as a leadership style, contribute towards maintaining the dynamics of a culture that supports innovation practice.

"A coach is someone who evokes passion and purposes in others, within the dissolving and reconstituting environments of our time."
Frederic Hudson[1]

Our world is constantly changing, and navigating increasingly complex human and technological systems requires collective team capability rather than individuals responding in innovative ways. Coaching is an effective technique for empowering people to behave in the ways innovation requires, such as taking risks, engaging in creative problem solving, acting with a low hierarchy, and working outside comfort zones. This chapter looks at linking the characteristics of coaching to behaviors and activities associated with innovation practice. It aims to provide insight into the potential of coaching to support an innovation culture within an organization by offering some practical guidelines and an example of how this has been implemented in an educational context.

What we mean by coaching

Broadly speaking coaching is an intervention involving assisting individuals or teams to instill the change required to reach a desired goal. It has been used in many different domains—such as sports, business, education, career development, and personal development—for the various purposes of participation, improved performance, increased capability, and transition. There is a range of different styles, theories, and approaches to coaching that can be drawn upon in different ways depending on the coaching context and goal.[1-3]

According to Bacon and Voss[3], coaching should center on aspirational and behavioral goals rather than be problem focused. Even if the ultimate objective is to provide a particular type of solution to a problem, coaching should focus on the processes required to get there, rather than on problem-specific tasks. In this way the coaching becomes transferable and can create transformation in individuals and teams, preventing the development of ongoing/long-term reliance on a coach being present in order to reach goals.

Coaching shares roots with mentoring and counseling as an intervention aimed at instilling change, they however differ in equity in the relationship between the parties involved. Mentoring has a clear power relation through the sharing of past experiences and expertise, while counseling is about healing past issues that are often deep and psychological.[1]

Coaching is compatible with innovation culture

As established in this book, intrinsic and extrinsic knowledge of organizational culture are interlinked and often intrinsic knowledge takes time to accumulate while tacit knowledge is innate. Being suited to tacit knowledge transfer, we can see how coaching approaches can be useful in supporting the more challenging aspects of organizational culture. Assuming organizational culture can indeed change, coaching can also work with individuals to help align personal values and goals with those of the transitioning organization. This is necessary in order for individuals to accept and be motivated to operate effectively in the organization.

But why is coaching specifically suited for an innovation culture? There are many other compatibilities between coaching capability and the features of an innovation culture, as described in the below table.

The features of an innovation culture	The relevance of coaching
Low hierarchy	Most coaching approaches—other than the autocratic styles often used in sports coaching—minimize, lower, or do not involve any power differentials in the relationship between coach and coachee.[1]
An open mind-set, creative problem solving, risk taking, big-idea thinking	A culture of coaching and coaching as a style of leadership can convey values and beliefs supportive of new idea development through using constructive feedback and asking rather than telling.[4] This may reduce the fear of failure and assist with taking risks with new ideas. Coaching is also suited to shifts in behaviors and is individualized and helpful to those for whom this is a new way of working.
Empathy	Coaching is suited to transition in behaviors, developing the capability to be mindful, aware, and reflective, which are useful traits in being able to empathize.
Collaboration and co-creation	Coaching itself can be collaborative in its approach to the relationship between coach and coachee, developing coaching pathways and goals.[1] It can also assist in soft skill development, such as developing the empathy and open mind-sets identified above.
Interdisciplinary teams	The ability of coaching to be individualized also applies to teams, meaning it can deal with the variables of different discipline compositions, working styles, and personalities.

How to make coaching work for innovation culture

There are many different typologies, approaches, and tools that are engaged in coaching for different purposes and contexts. The following provides a guide to the ways coaching may be used to support an innovation culture, allowing space for the specifics of techniques under each area to be tailored to individual organizational contexts.

1. Adopt coaching as a leadership style.

Instead of the autocratic dictation of tasks and performance reviews, constructive and individualized feedback (where leaders ask rather than tell) is used in coaching as a leadership style. It is inclusive, collaborative, and minimizes the power differential by engaging a conversational style of reviewing performance. Studies exist that have found that leadership coaching can lead to increased efficiency and that it is likely to foster innovation in work teams.[5] Bianchi and Steel also suggest that leadership coaching creates a coaching culture that leads to broader innovation practices in teams.[4]

2. Coach teams.

Team coaching can have a direct effect on the support of innovation.6 Coaching project teams supports shared values and goals to be developed, assisting coherency in collaboration. In large organizations, it may not be possible to invest the resources to coach everyone individually and so this provides a mechanism to expose everyone to coaching approaches.

3. Embed coaches internally in organizations or departments.

To be effective, a coach needs to understand the overall system and dynamics between people.[1] It is much easier to develop a deep-seated understanding if you are part of the organization or department that you are coaching within.

4. Make sure coaching is aimed at process and behavior.

To ensure coaching is developing cultural norms, coaching should not be used to identify the tasks needed to execute project-specific outcomes. The facilitative, instructional, and transformative typologies of coaching proposed by Bloom in the context of education offer appropriate frameworks[2], as do the evolutionary and engagement approaches proposed by Brockbank.[7]

5. Decouple performance requirements from coaching activities.

While within organizational contexts the underlying objective of coaching is always to increase performance in some respect (to stay competitive and relevant, to increase market share, to profit, to improve services, etc.), the goals of coaching do not need to be linked directly to these objectives. The fear of judgment regarding performance and employment security may be a barrier to openly and honestly reflect upon and explore one's behavior and conduct, which is needed in order to transition and behave in new ways. Ensuring coaching is not linked to performance metrics may help people engage more openly with coaching.

6. Embrace a culture of coaching for a culture of innovation.

If coaching as an approach becomes ingrained as a normal way of doing things for the members of an organization or team, peer coaching can emerge. This can lead to shifting to a shared model of culture maintenance rather than the responsibility lying solely with individuals in leadership positions or coach positions. It also aligns with the open mindset required by innovation practice and the sharing of both implicit and explicit knowledge.[4]

Challenges to coaching success

Of course implementing coaching approaches does not automatically mean you will be able to successfully implement an innovation culture! There are a number of challenges surrounding coaching and innovation culture, including the following:

- **The timeframes involved.** Time needs to be allowed for people's internal methods to process and action transitions in behavior.

- **The readiness of individuals to respond to coaching.** Psychological issues, low commitment/motivation levels, and the lack emotional interest to engage can all act as barriers to effective coaching.

- **An understanding of the specific context in which coaching exists within an organization and the broader context in which the organization exists.** This is necessary in order to understand how to tailor different coaching approaches and make them relevant. What are the socio-cultural, political, and technological conditions an organization is located within? How large is the organization? What is the purpose of the innovation culture?

- **Whether organizations can change culture is debated.** A well-established organization with distinct hierarchical structures may not have the conditions to be receptive to transitions in beliefs, values, and behaviors.

- **The skill and experience of the coach will impact on the effectiveness of the approach.** The ability of the coach to develop a rapport and trust with those being coached will impact on the engagement, as will the coach's repertoire of coaching techniques and tools.

Coaching in Design Factory Melbourne

Based in Swinburne University, Melbourne, Design Factory Melbourne (DFM) shares the same principle as Aalto Design Factory (ADF): to operate as an innovation platform. In the context of education, students and researchers work on projects in partnership with companies and organizations with the goal of exploring innovative and meaningful solutions in relation to the project brief. DFM engages with coaching in different ways:

1. It uses coaching as a leadership style, allowing staff members to find areas within the organization that they are passionate about so that they become invested and feel supported in implementing new ideas and innovations in the activities they engage in. Practically, this has lead to the development of new academic programs, experimentation with pedagogy, and the creation of new research projects. All three can be seen in the example of a new post-graduate program that is trialing different models for industry engagement for master's and PhD students, which in part involved the generation of a new research project to explore new materials and applications for recycled materials.

2. DFM has a dedicated staff position titled Coach. Rather than having responsibility for formally coaching individuals, the coach facilitates activities and events for the broader community of students, staff, and external partners that demonstrate the cultural norms expected of an innovation culture. Through this and being present in the space, the coaching of individuals occurs on a needs basis within the organization through social and informal interactions. For example, the Coach has organized a pizza making session with the challenge for teams to create a pizza that represents innovation. This used a familiar and fun task to introduce and expose students to the basic processes of collaborating in teams, articulating individual values, and engaging in negotiation about how the individual values across a team can be integrated into one outcome.

3. Coaching is used as a complementary activity in experiential, project-based learning and teaching activities. Coaching is not linked to assessment (the evaluation of performance). For example, the coach introduces and enables activities such as facilitated feedback sessions. Because the coach is not involved with the project's assessment, power differentials are minimized and students feel less restricted to be open and honest in their engagement. Through student surveys, this was identified as being one of the more successful techniques for supporting interdisciplinary collaboration and the transformation of behavior.

SECTION III: THE PHYSICAL AND VIRTUAL DIMENSIONS OF CO-CREATION

The physical and virtual dimensions of co-creation

This section focuses on the physical and virtual foundations of innovation. We take a look at how organizations can benefit from paying attention to their work environment and putting effort into it and especially the way the space is constructed in their pursuit of innovations and creative initiative and collaboration. While influences may be subtle, research has shown our environment to systematically exert an influence on our behavior. Our environment has different affordances, making some actions easy and others difficult.[1] On the other hand, our surroundings can communicate what kind of behavior is expected and valued. For example, researchers from Stanford and Yale found that people were less cooperative in negotiations when in a room with a boardroom-like table, expensive pens, and briefcases than they were in negotiations when using pencils and backpacks.[2]

The recurring theme in this section is how physical, virtual, and social environments are linked and how they shape our behavior and how our behavior shapes them. Senni Kirjavainen, who has been on board Aalto Design Factory (ADF) since its start, discusses some of the key principles in designing working environments that support creativity and co-creation, with examples from the spatial environment of ADF. In the following chapter, Tiina Tuulos and Matti Hämäläinen point out (with examples and lessons learned from ADF) how the rules, guidelines and objects in physical spaces give us cues on how to behave. They describe how new practices are created and reinforced by spatial structures, as well as describing the brave individuals who set the norms of behavior. The two subsequent chapters offer a take on virtual spaces. Alicen Coddington and her colleagues from Design Factory Melbourne at Swinburne University, Australia, present three cases of open, collaborative environments, illustrating the physical and virtual boundaries and their interaction. Finally, Tuuli Utriainen and Joona Kurikka from CERN IdeaSquare enlighten us on the challenges virtual teams face when designing and developing new solutions. Most difficulties emerge in the convergence phase of making decisions, defining the problem, or specifying a concept, but how can these difficulties be tackled?

Taken together the four chapters in this section illustrate how our working environments are multidimensional, stretching from physical to virtual, and the social aspects of space. They remind us of the importance of our environment in enabling creative work, collaboration, and building a community.

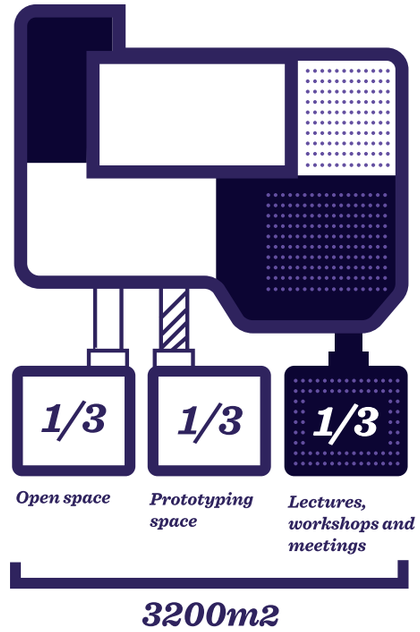
The spatial history of ADF

ADF officially opened its doors in October 2008. The history behind this initiative goes back to 2006. The project started to come together with the launch of an experimental research project at Helsinki University of Technology called the Future Lab of Product Design (FLPD).[3] The FLPD was started in order to explore alternative spaces, working environments, and methods for supporting interdisciplinary product development work. In addition to, e.g., practices and a new format of learning, spaces for different needs were also designed, built, and tested. These included, for example, prototyping, machining, and testing, as well as spaces for group work and the informal gatherings of students.

The experiences from the FLPD were turned into a new, bigger experiment and environment in 2008. An old building previously occupied by VTT Technical Research Centre of Finland was slowly turned into the experimental learning platform that it is today.

The space is ever-changing and designed to be flexible. As the space is used to experiment with new ways of teaching, learning, and interacting, it is intentional that the facilities are used as an experiment as well. The space is designed to increase the chance for serendipitous encounters between students, researchers, company representatives, and ADF staff, as well as random visitors. During the first years of ADF all community members shared spaces with each other, regardless of their tasks. Currently there is a space for researchers, another for teaching staff, and a third space for entrepreneurs in order to facilitate and improve everyday collaboration between people with similar tasks and interests.

ADF is open for students around the clock, even though the staff is not available 24/7. This is made possible through trusting the users of the space, and sharing the responsibility for the premises and mental ownership of them. Despite operating for nearly ten years now, no major problems have been caused by this sharing. However, a number of physical cues have been iterated in order to communicate the responsibility that comes with this freedom, helping to prevent some of the smaller issues in facility upkeep.



SPATIAL SOLUTIONS SUPPORTING CREATIVITY, INNOVATION, AND CO-CREATION

Senni Kirjavainen

Key points

- Think beyond aesthetics when changing from cubicles to teamwork and open-plan offices
- Provide clear cues on how the spaces can be used and modified
- Allow spaces to be modified according to the needs of different individuals, tasks and phases of work
- Place people who should work with each other near to each other - but also balance collaborative spaces with possibilities to escape distractions

The ways we work and the places where we work have changed during the last decade, and during this change, spatial design as an organizational interest has boomed. It is clear that our working environments - the possibilities the space allows and the way our working environment is arranged - have an effect on our motivation, productivity, and job satisfaction and have other important outcomes.[1] In recent years, many companies have developed their work environment to better support innovation, and many co-working spaces have been opened to house freelancers and creative professionals in different countries.[2] Also, many academic institutions have started their own learning hubs and co-creation spaces in order to positively affect work and learning—Design Factories being amongst these examples.

New technologies and the increased pace of the globalization of companies and communication have also changed the ways we work, how we perceive time and how we are expected to perform in our work.[3] In many countries, the manufacturing industry is in decline and knowledge work has a bigger role than before. There are new professions that have only existed for a while and more are emerging as technology and societies develop. The design profession is also expanding and in flux.[3] Regardless of the organization at hand, knowledge workers do not stay in one place nor do they only work during fixed hours. Also the content and mode of their work might vary a lot depending on the day. This requires flexibility not only from the workers or organizations but also from our working environments. As a result, in recent years work has moved from being conducted in cubicles to being conducted in open-plan offices and easy-to-access spaces for teamwork. This chapter focuses on how the physical work environment and especially the way the space is constructed can support co-creation and creative work (the following three chapters delve more into the social and virtual dimensions of the work environment).

Adaptability as a key requirement for workspaces

The recently manifested creative environments, hubs, and innovation laboratories often look very similar to each other. There seems to be "a DNA of aesthetics" that these spaces share: colorful furniture, motivational statements, whiteboards on wheels, and piles of sticky notes. However, there is more to creative environments than colorful walls and motivational posters. This aesthetic has become so common that there might be many cases where only the visible surface is created without sufficient thought and reflection. What should lie beneath this recurring look is a pursuit to support different activities, and the objectives of creating a space should not be focused on chairs, desks, or square meters but on the needs of the users and organizations.[4] A workspace should allow people to modify the space according to their needs, and it should communicate the ways of acting in that environment.

The way our offices, learning spaces, or meeting rooms are designed can have a direct and significant effect on work performance, learning, new products, and ways of working. Many studies have explored the idea of innovative spaces shedding light on what kind of working environments support creativity.[4-6] If we are tuned into thinking about the issues we are going to be dealing with, our environment can help us connect thoughts and find links between concepts.[4] Some environments can facilitate idea creation and experimentation better than others, especially if

a person is already geared towards breaking away from conventions.[4]

To prompt innovation, the environment we work in should enable collaboration while being modifiable to meet the varied and changing needs of the users, not forgetting about the possibilities for communication and working that adding virtual space to physical spaces can offer. Different stages of creative processes also require different kinds of spaces, sometimes more private and sometimes more communal,[7] which also supports the idea of modifiability. There should be a possibility for the users of the space to develop and modify the space to fit the users' current needs and this possibility should be built into the design of the space.[8] A physical space also gives us mental cues on how to behave. If a working environment is designed so that it conveys a message that it is desirable to take action and develop the environment, the users are more likely to do this. It often comes down to small details that guide the users of the space. For example, an unpolished feel and mobile furniture suggest that one is allowed to make modifications to the environment and can encourage new types of behavior. Consequently, creating a polished environment is not necessarily desirable.[8] At Aalto Design Factory (ADF), there are two kinds of changes users can make in the spaces. First, the spaces offer opportunities to temporarily modify the set up—for example for a teaching session or prototyping session—where the facilities are "reset" to the original configuration after the session is over. When teachers at ADF were interviewed, they described how the facilities had encouraged them to work in a more student-oriented and hands-on manner than previously.[9] In addition, sometimes users develop the space to better meet their needs together with the staff, and these changes

While our work environment should be attractive, this does not only refer to visual attractiveness. Even though visual attractiveness is debatably hard to measure, it has been shown that other aspects of attractiveness—comfort, location, and architecture—are important features of a workplace."[5] The place we work in should reflect our needs[4] and thus give us the ability to experiment and find the right rhythm, as well as offer ways of working that suit us and allow collaboration, prototyping, and all other shapes and forms of creative work.

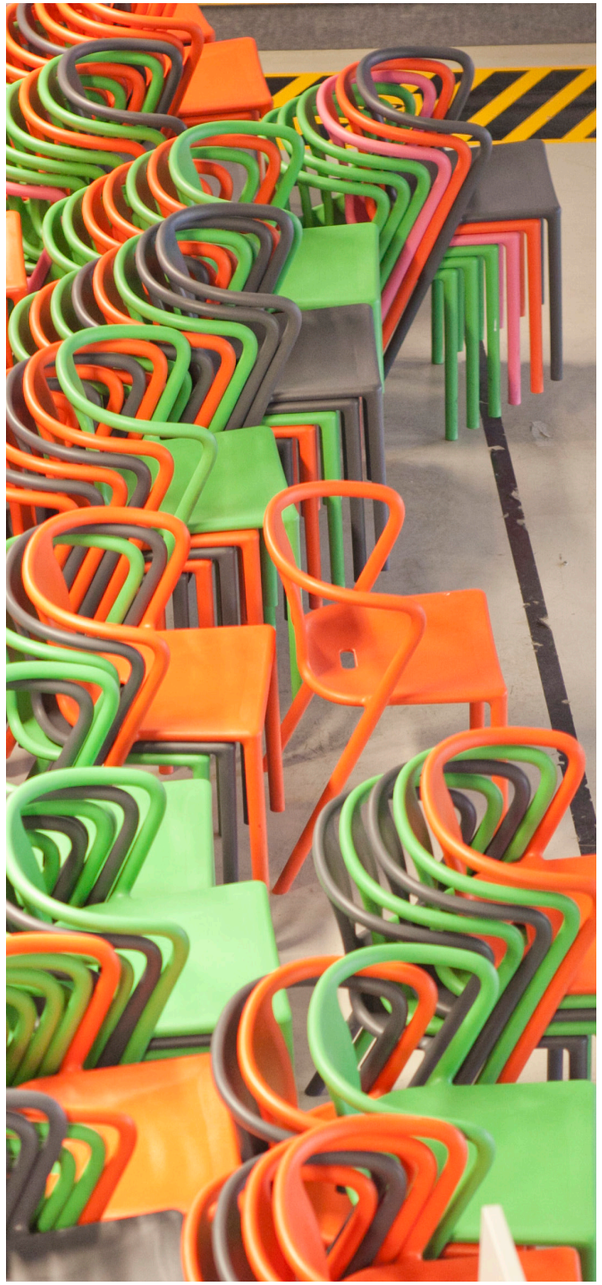
Physical proximity sets the scene for collaboration

A study on ADF conducted three years into its running showed that having a common physical space and spatial arrangements supporting interaction are perceived to enhance becoming part of the community. These spaces include, for example, rooms and offices that one shares with not only with one's closest colleagues but also with other members of the community. At ADF, no one has his or her own office, regardless of organizational status. Researchers from different research groups occupy one part of the building, teaching staff from multiple courses in different disciplines occupy another part, and so on. It is a given that people can move between these spaces according to their prevailing needs. On the other hand, clustering people in the building according to their primary activities (rather than the organization they come from) can help to lower the threshold for reaching out to your neighbor, as you know you are likely to share some interests and challenges.

The study on ADF also revealed that simple solutions, such as creating open offices or centralizing coffee makers, can support and facilitate sharing and openness in an organization.[8] Teamwork happens in spaces that are designed to support teamwork. It is futile to expect community members to interact, engage, and collaborate if they do not meet each other during their time at the office. It is easy to see the sense in this: when the environment steers community members into mingling, discussing, and interacting, these actions are much more likely to take place.[8] The physical proximity of people in a space was perceived as highly beneficial in the study on ADF. Development collaboration increased with physical proximity—distance being the biggest obstacle to co-creation. Being located in the same building does not do the trick as being located in different rooms is enough distance to hinder collaboration. There has to be the possibility to interact with others, overhear discussions and catch up with other members of the community.[8]

There are also drawbacks to all the openness. In a 2011 review, Davis et al.[1] summarized the benefits as well as the risks of open offices. The risks include distraction from work, noise that can lead to dissatisfaction and further to bad work performance, and reduced privacy. The work environment should be well thought out in order to avoid the potential risks from outweighing the positive effects of openness.[1] The challenges of open-plan offices and shared spaces also came up in the study on ADF. Privacy was one issue that the interviewees were concerned about and some community members felt that they needed more privacy than that which the environment allows.[8]

As discussed in the next chapter (Bridging physical and social space: Practices and behavior in co-creation platforms), a space that has been deliberately



designed for supporting co-creation can also facilitate the process of cultivating a desired social environment. Spaces supporting creative collaboration should be designed with intention and starting from the users' needs and the space should also reflect them, the community they comprise, and its values. The workspace is a physical representation of the organizational identity and often also one of the first things we experience in regards to an organization.[5] Our physical work environment provides a story of who we are,[5] it can even lay a foundation for the whole organizational identity[10] and have a great influence on our organizational culture and its formation.[11] For example the physical environment of ADF is—among other things—designed to support trying things out, which is one of the core values of ADF. Therefore the spaces provide low-threshold possibilities for rapid prototyping, machining, and experimenting in other ways as well. ADF or any other co-creation platform is more about the community than it is just walls and furniture, and the environment plays an important role in creating the ways the people that make up the community go about their days.

BRIDGING PHYSICAL AND SOCIAL SPACE

Practices and behaivor in co-creation platforms

Tiina Tuulos
Matti Hämäläinen

Key points

- Physical spaces affect our behavior and can support interaction
- Innovation-supportive environments are built on new types of practices and active reinforcement experiments
- Brave individuals who set an example and have the courage to act differently are needed in order to build new ways of working
- Rules pervade spaces and they can be used to guide us towards positive change

Our surrounding environment—consisting of physical, social, and mental space—has an influence on our ways of working. The environment affects behavior and it can have a great impact on what people assume to be an acceptable form of conduct, hence it inevitably affects our established practices and our everyday ways of working. A deliberately built environment can be a powerful tool for restraining behavior, but it can just as well act as a supportive platform that nurtures creativity, facilitates experience-based learning, and encourages all forms of interaction and informal knowledge sharing.

With spatial design guidelines and principles, we can encourage certain types of behavior and activities in preference over others. However, the affordances of an environment are not only tied to the construction of the physical elements, they are also a mix of the surrounding culture and ways of working. Physical elements do more than just keep us warm and safe. The physical space is full of mental cues that implicitly tell us how to use that space and even how to act and behave. Considering this, it is culture and practices that finally guide our ways of working. Some environments support certain activities better than others, and therefore it can be inferred that there is a strong connection between an environment and the type of organizational culture that prevails within it.

This chapter looks into what kind of environments we need in order to support interaction and modern knowledge work, and how new practices, interaction, and collaboration can be facilitated. We describe some of the principles of interaction and community building from our own experience that has taken place at Aalto Design Factory (ADF). Even though we use learning spaces as an example, since the field we operate in is higher education, we assume and know from experience that the essential features that support experiential learning within learning spaces are applicable to other types of organizations as well. After all, sharing knowledge and information is the most important thing and it should happen both in lecture rooms and in corporate headquarters.

Environments for experimentation and learning

In the field of education the need for redesigning learning spaces is based on the growing interest to develop experiential and non-theory-based learning[1,2]. This sets new challenges to the classrooms where learning traditionally takes place. The term experiential learning refers to the type of learning that is not theory-focused, teacher-centered, or an individual's sole endeavor but rather all the opposites of these. It challenges traditional views not only in perceptions of teaching and learning but also in interactions taking place, hierarchy, attitudes, and physical spaces[1,3]. The substance is no less important than before, but the focus is on how we are learning it.

Universities have started to pay much more attention to the spaces where teaching and learning take place and where people interact. This is partly since the excellence of a university is not just based on the people and quality of research but also "on the quality of the physical environment," which influences accidental encounters, interdisciplinary interaction, the learning culture, and ways of working[2]. We learn best when we are interacting with each other but it is often the case that traditional classroom settings

discourage students from engaging in a genuine conversation instead of encouraging them to challenge themselves. The same applies to meeting rooms—people gather around a huge conference table and the manager sits at one end, not creating a proper atmosphere or structure for open discussion and opinion exchange. The challenge with the layout of traditional classrooms has led to a situation where the most valuable and significant conversations are held spontaneously, after the classes[3]. It is often after a class or a meeting that we get to share thoughts with our peers and are confident to ask the right questions, state our opinion, and clarify any misconceptions. Largely due to this mismatch of physical spaces and the desired interaction, ADF—among other similar platforms—was established in 2008. It is designed to be an informal, student-centric, flexible, open and interdisciplinary learning platform that facilitates collaboration and experiential learning.

Social learning spaces

The shift away from classrooms and towards virtual platforms increases the role of physical space as the host and facilitator of informal learning[4]. For that reason, physical learning environments are encouraged to include purpose-built informal social learning spaces[4]. These informal social learning spaces enhance the student experience and student engagement by fostering active learning, social interaction, and the feeling of belonging[5] and they also act as co-working places.

Physical learning environments should include purpose-built informal social learning spaces

Social or informal learning happens beyond the formal settings of teaching and information sharing. It occurs when people share experiences in direct experiences and interactions with others, and when they participate in activities based around real-life problems. In such situations mentors help novices to become experts and learning is reproduced by the more experienced for the newcomers[3,6-8]. In order to get the most out of places of social learning, the perception of work needs to be broadened. Working does not only include individual tasks and activities that are carried out in meeting rooms or offices, it also includes discussions and knowledge sharing that happen in corridors and cafeterias[4]. Physical spaces are important for the social environment to develop as they act as the medium that enables informal gatherings and encounters to happen8 because such spaces afford a place to be, a place to meet, and a place to learn from others[3,7].

The affordances of a space

Whenever you arrive at a place that is new to you, you will most probably look around and quickly analyze the environment, evaluate the assumed norms related to it, and adjust your behavior accordingly. This process takes place subconsciously and in most cases does not call for any further thought, even though the adjustment has a big impact upon you until you go somewhere else. For example, a quiet and calm environment like a library might make you slow your pace and lower your voice when you talk, while a busy market place might encourage you to speed up your decision-making cycle and respond to enquiries in an exaggeratedly outward and lively manner[9]. These affordances that we interpret from spaces are essential in guiding our behavior and ways of working[10,11].

The environment we work in can have a distinct impact on how we behave. Walls and doors are necessary for managing noise levels and sustaining an optimal climate within a space, but they are also used as tools to control people's behavior. Walls separate people and reduce interaction between them, and corridors guide us towards certain places, while keeping us away from others. For example, open or closed doors send strong signals about willingness to interact with others. Well-designed offices, where these effects have been taken into account while being designed, afford serendipity[12]. There are many things a spatial designer can do, or that we all can do in our working environment, to support serendipity or "planned coincidences".

The theory of affordances can be used as inspiration to design better working and learning spaces that have a balance between privacy and proximity[11]. Walls, doors, and curtains are essential in creating the feeling of privacy in any space as they allow people to share their ideas and talk openly with others about topics that should not be heard by all. However, they can also reduce the chances for interaction as people do not accidentally meet or bump into each other. Privacy is not the only important thing when designing great spaces for working and interacting. With glass walls and see-through doors we can enable propinquity, the feeling of closeness, while enhancing nonverbal communication and visibility. Opportunities for eye contact and nonverbal communication have been shown to have an influence on the communication patterns, cooperation, and social interactions in a space[13]. We all know how seeing a colleague at the parking lot when coming to work or in the corridor might remind us of an important task or spark up new opportunities.

Generally, water coolers, copy machines, and cafeterias are good examples of magnet spaces and social areas enabling propinquity and proximity. These are places that are used by all and bring people together, resulting in casual interaction and serendipitous encounters that can lead to collaboration[11]. The smaller the physical distance between people, the more likely they are to interact[11,12] and especially tacit knowledge is best shared when people are physically in the same space[14]. Such casual interactions build trust, cooperation, and innovation[15] and also increase creativity and the feeling of togetherness[16], not to mention strengthen the community and feed positively into organizational culture[17].

A "social workplace" is a central space for sharing information and knowledge. It is a place where social, physical, and virtual spaces are in balance[18]. It is built through shared rituals and practices, which increase the feeling of togetherness and belonging to a community[19]. Such rituals are, for example, a weekly breakfast or an informal gathering on a Friday afternoon, where people can exchange thoughts and ideas, and discuss non-work-related topics in an allowing atmosphere[19,20]. Hence, space that enhances interaction is not only physical but also strongly a social construction that should be also taken into account[11]. Physical structures can hinder or support informal interactions in a space, and similarly social designation can encourage people to participate in informal knowledge sharing or to stop that happening altogether. Social designation of the organization directs our communication patterns towards a preferred direction.

The rules of a space

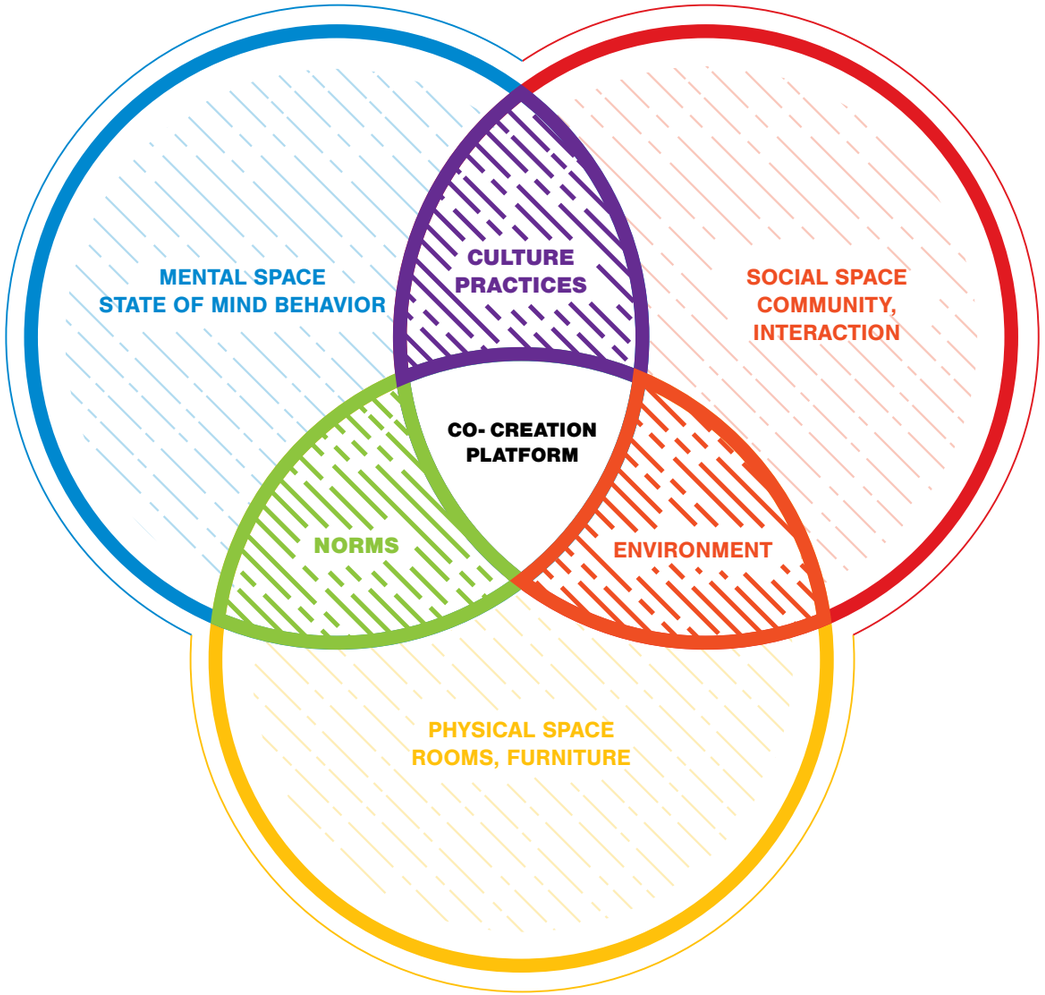
As said, the way a space is constructed has an effect on the way we behave in that specific environment. This applies just as well to working environments and homes as it does to schools.

How to behave in certain environments?
What are the prevailing rules?

Already from preschool and primary school onwards, we are taught how to act and behave in a classroom. Social norms and cultural expectations exist everywhere around us and we obey and know these rules even without written guidelines and instructions. This results from us having learned them over the course of time and through others' examples[9]. We have a mental model that we use for deciding how to act in specific situations and environments, thus there is usually no conflict in interpreting the right kind of behavior in places such as a classroom setting since most classrooms are very similar and all afford the similar things[21]. Place and normative behavior are connected, guiding us and helping us evaluate what kind of behavior is appropriate and what is out-of-place[9]. Being out-of-place means that a person is acting against the code of conduct instead of carrying out the expected behavioral patterns—"not matching the expected relations between place, meanings and practice"[9]. For example, in an environment that has been constructed in an unlikely or new kind of way, like in an experimental classroom, the way to behave might not be obvious to the users from the very beginning[9]. As the users are not familiar with the rules and norms of the space they can become confused, since the space seems to afford new things[11].

This behavioral adaptation is also known as the chameleon effect [22,23] and it is based on a series of cues linked to the environment—consisting of both the physical and the social space around us. Places do not inherently have certain natural or obvious meanings[9] but instead the meanings and rules are only created in a social context. It is people who give meanings and rules to spaces. However, rules in a certain environment can also act as catalysts for acting differently or atypically, as the rules are what give the users permission to act in an unconventional or nontraditional way.

The figure on the right depicts how mental, social, and physical spaces are interconnected and how it is the people–the community—who create the culture and practices within an environment, based on the prevailing norms and rules.



Bridging physical and social space in practice: Case ADF

While academic research focuses on building theories and analyzing existing practices, and is strongly biased towards deductive reasoning, ADF and many of its affiliate partners have acquired a different approach of starting from the problem and the practice, and building the way through research. This approach is based on the idea of exploring opportunities, having a low threshold to testing and exploring, and creating new, agile ways of working. The primary outcome of an approach like this is first-hand practical experience of what works and what does not. Experimentation and exploration in an environment like ADF revolve around trying something new, while being open and prepared to fail over and over again and learning from those failures. Sometimes the experiments are successful, in which case you might pop a bottle of champagne and continue in the direction that proved to work. But perhaps more often than not, these experiments fail, forcing you to take a step backwards and learn, reframe, and rethink.

Managing an environment's impact on behavior also calls for new types of leadership and organizational practices. Through experimentation ADF has discovered and developed a comprehensive set of policies, practices, and guidelines for operating and managing an inspirational, continually evolving environment. This set is based on a symbiotic relationship between the physical environment and the people who use it—the community. A deliberately designed physical environment can facilitate the process of cultivating a desired social environment but only when the community is allowed and encouraged to develop its environment further.

"We know this works in practice. We're not sure if it works in theory,but we certainly know that it works in practice!!"
(Prof. Kalevi Ekman, the father and Janitor of ADF)

Physical meeting spots designed for serendipitous encounters and "planned coincidences"

In all offices and buildings there are integrative spaces—such as stairways, corridors, escalators, and aisles—that lead and link to other places in the building. Some of these places are routes to important locations, such as coffee machines, toilets, the copy machine, or the office of a key person in the organization. These places encourage movement and are central for enabling "planned coincidences", thus they become the "interactional hotspots" or magnet spaces[24-26]. Obviously such magnet spaces give people reasons to come together in a certain space and interact[24-27]. When making decisions (regarding the physical space) that enable magnet spaces to evolve, we can facilitate interaction and increase encounters. Bringing people together is essential, but it is also important to focus on how it is done and what happens in those encounters, or as we call them, "planned coincidences".

Kafis: a hub for serendipity

Kafis, the social heart of ADF, is a mixture of a café, an office, a kitchen, and a living room. It is located in the middle of a walkway, a central place in the building. Hence, several people walk through or come to sit there every day. As ADF has over 3000 m2 over three different floors, without Kafis it might be that you would not see many of your colleagues and other community members at all during your day. Kafis can seat approximately 30 people when packed. This makes interactions likely and keeps colleagues close.

As we mentioned earlier, rules are not only restrictive, they can also guide and facilitate positive change in action. At ADF there is one special rule: the one coffee machine policy. This means that the only coffee machine in the whole building is located at this open, central place. This gives a functional reason for most of the users of the space to come to Kafis and spend time there. In the mornings there are people queuing for their first cup of coffee and wishing good morning to each other. Throughout the day, you never know whom you might accidentally meet by the coffee machine. It is by the coffee machine that the unplanned meetings occur and strangers become new acquaintances. The coffee machine is the magnet at ADF, the reason for many people to move from their workstations and interact with other people.

There is an urban myth going round at ADF saying that the coffee machine is adjusted to brew your coffee as slowly as possible, just to make sure people have more chance to talk to each other while waiting for their dose of caffeine. We are not quite sure if this is true or not and it does not really matter. You get the idea anyway.

The core principles of the space

- Accessibility: Kafis is accessible all the time, by anyone, open, situated along the main walkway of the building
- Purposeful: Anyone can have a reason to come to Kafis, increasing the chances of informal knowledge sharing—it is not only seen only as a cafeteria or kitchen, but also as a valid working area and a part of the activity-based spaces at ADF
- Open for use: Everyone has ownership of the space
- The place is shared: It is everyone's space, the social heartbeat of the building

Guidelines for keeping the show running

- The "No personal servants" policy: Everyone cleans up their own mess
- Get to know strangers: Talk to strangers

When facilitating interaction, it is good to identify hotspots that are places where many people have a reason to visit or walk by during the day. Magnet spaces afford serendipitous conversations[25] and increase the opportunity for interaction and, as Backhouse and Drew[24] found in their study on interaction patterns at a workplace, many consultations and discussions were neither planned ahead nor conducted with the person with whom they would have assumed to have conducted them. Instead, the consultations were caused by accidental encounters, which were due to the environment.

The lobby: The open working area replacing a reception

A space does not have to be closed to serve privacy. ADF's lobby is the entrance of the building and it is not just a place through which to enter the space but also an open working area where people work alone or in groups, talk over a cup of coffee, or challenge each other to a game of table soccer. The space hosts several activities and even though it is an open space, many private conversations can take place since individual conversations blend into the background noise. However, in a space like this it is difficult to moderate the level of privacy since everyone is perceived to be open to interruptions and discussions. We have a tendency to think that a person sitting in a shared open space can be disturbed and is available for interaction[24]. Here, the shared ways of working and practices of the organization play a significant role since, when designed well [24,25], even an open space that might not be very suitable for work that requires concentration[28] can afford and enable rich interactions.

The core principles of the space

• Accessibility: The lobby is accessible all the time, by anyone, open
• Purposeful: Everyone needs to come into the space since it is the entrance of the building
• Transparency & visibility: Posters, prototypes, products etc.; the space is available for serving information and hosting conversations
• Shared: It is everyone's space—many external stakeholders join the daily buzz on an everyday basis
• Lobby shift: There is no reception or full-time receptionist but instead, there is a rotating shift amongst the active community members who manage the daily practicalities of the house (e.g., receive post, help event organizers, loan equipment)

Guidelines for keeping the show running

• Get to know strangers: Talk to strangers
• Ask and get help from anyone: It is not just the official staff who offer guidance and assistance with tools, materials, or ways of working in the house—any student, researcher, or other community member familiar with the system may also offer assistance.

Community breakfast brings people together

ADF hosts several projects, courses, and activities, and it is quite impossible to stay on track of everything. Projects that interdisciplinary student teams are tackling in collaboration with industry are at the core of ADF. These projects usually require getting user feedback, testing prototypes, and validating ideas with outsiders. But how do people get to know about ongoing projects and, on the other hand, how do the students get feedback for their early-phase ideas? There is weekly community breakfast in ADF's Kafis called Breakfast at DFfany's. It is organized by student teams or other community members in rotating shifts. Student teams organize the breakfast and every week a new team gets to choose what they serve and how they want to utilize the community to help them with their project. This informal weekly gathering is a reason for people to come together and get to know activities, people, and projects they might not get to know otherwise. The breakfast is not only a gathering for the community of ADF as it is also open to outsiders—anyone who is interested in getting to know new people can come. The breakfast is simply a great way to start your morning, but it can also be the start of a new company and adventure. This happened to one young innovator who came one morning to pitch his idea to the rest of the community. A professor overheard the pitch and got enthusiastic about the topic and took it up as a challenge on his Product Design course. With the course the young entrepreneur was able to build a team around him and develop a new product.

In addition to having fruitful conversations with other community members when attending breakfast, organizing the breakfast is a great opportunity to gain ownership of the daily activities and get a fast introduction to the ways of working. Soon you are no longer just a user of the shared spaces and activities but also the creator of these activities.

Lately we have also experimented with new ways to increase the interaction by introducing breakfast facilitators. This facilitator can be anyone attending the breakfast. If needed, the person supports and sparks interaction during breakfast by, for example, asking the student team to pitch their project to others.

The core principles of the activity

• Accessible: The breakfast is open for all
• Keeping things informal: The breakfast has no agenda, no formal form
• Flat hierarchy: One week it might be the students wearing the apron and organizing the breakfast and another week, the professors—everyone participates
• Purposeful: Everyone has a reason and permission to participate in the breakfast—food is vital to us all
• Co-creation with the community: The breakfast is organized with a rotating shift
• Trust and ownership: The breakfast integrates the students and other community members into the everyday life of ADF by giving them full responsibility for organizing the breakfast

Guidelines for keeping the show running

• Get to know strangers: Enjoy your breakfast while getting to know new people
• Shared responsibility: The breakfast is a communal gathering organized and paid for by the community—the breakfast runs itself in terms of budget

Studies have found that food and drinks bring people together and opportunities for informal gatherings should be enabled[8,25]. If the physical space is designed well, people can also do "real work" while taking a break or enjoying their breakfast[25]. Hence, food can make working more efficient and bring people into important, unplanned conversations.

Several different concepts including food have been tested at ADF and have been more or less successful. The main driver for all of these experiments has been to create purposeful and valuable reasons for community members to come together to exchange thoughts and ideas, and get to know each other. The challenge however is often the sustainability; how to keep a gathering running week after week and month after month in a way that is not too time-consuming for anyone, does not take the lion's share of the available resources, and is perceived as valuable by the participants.

We have experimented with SoupsUp, a standing soup lunch concept in the lobby of ADF, Smoothie Wednesdays, an afternoon super boost from a self-

made smoothie, and with a 100 Pulla afternoon, an event where you changed your development idea into a freshly baked pastry. All of these events worked well for some time, but in the end they were too much dependent on individual champions making them work. The need and desire for gathering people at informal get-togethers has not vanished, but the key is to figure out how to make them sustainable and co-organized activities.

The license to act differently

One of the inhabitants of ADF for several years now is the research group MIND. MIND focuses on industry-changing innovations and they are very much interested in the practices and norms that surround us. To support positive change they created a tool, a network of agents who have a license to act differently. Every agent gets an "ID card" to remind her or him about this power to choose. The main goal is to encourage people to observe their everyday surroundings and have the courage and permission to make—or be—the change they would like to see. We have implemented some elements like this to ADF, supporting non-traditional behavior in a university setting. To encourage new ways of acting, some other elements supporting non-traditional behavior in a university setting have been introduced; the Hugging Point for example. The Hugging Point is a big carpet in the middle of Kafis with a sign that authorizes one to hug and be hugged when standing on the carpet.

The core principles of the experiment

• Safe for all: Tools for acting differently; a rule is that new ways of working must be encouraged
• The power of an example: When one person has the courage and ability to be out-of-place and act differently, others are more likely to follow the example

Guidelines for keeping the show running

• No judgment: Be open to new experiments, to new ways of working
• Shared responsibility

OPEN SPACES, OPEN COLLABORATION

Alicen Coddington
Dolly Daou
Christine Thong
Anita Kocsis

Key points

- Physical and virtual working and learning environments provide prompts for collaboration and co-creation through open and dynamic spaces.
- Open collaborative environments lead to transformation through activities and through the perception and interpretation of such spaces, co-creation being a key element in establishing and developing spaces.
- Corporations and universities are no longer solely in the domain of local entities. The increasingly rapid expansion of globalization means that future working and learning environments across these sectors need to be constructed to facilitate diversified activities, from the individual to the collaborative and from the analogue to the digital.
- Design Factory Melbourne, Police Married Quarters, and Telstra Sydney HQ are three different but synergistically connected working and learning environments seeking to re-envision their practices in order to facilitate these future goals.
- These entities are attempting to challenge the status quo of their individual environments in order to develop and support change in their cultures and practices and thereby create working and learning environments for the future.

Open collaborative working and learning environments

This chapter discusses collaborative corporate and university environments through three case studies: Design Factory Melbourne (DFM), located at Swinburne University of Technology, Australia; Police Married Quarters (PMQ), located in Central Hong Kong, Hong Kong; and Telstra Sydney HQ (Telstra HQ), located in Sydney, Australia. These three case studies are different but synergistically connected as they are all working and learning environments seeking to re-envision their practices in order to facilitate collaboration and co-creation through environmental design. These types of collaborative working and learning environments are emerging across the world as they support collaboration and co-creation. This collaboration is explored here through three main perspectives: 1) physical and virtual boundaries; 2) open spaces, open collaboration; and 3) the multi-functional space.

People have argued for decades about the definition of innovation. The consensus now seems to be that "innovation is not—and, as it seems, never has been—something that is accomplished by an individual."[1] Instead, innovation is a social and a collaborative activity. Creativity is at the heart of innovation, so an environment that aids and fosters collaborative team processes is essential for the innovation process. Creativity occurs within the everyday. However, Bruce Nussbaum, a Professor of Innovation and Design in New York, argues that true creativity needs a space that is separated from the mundane activities of daily working life. In team creativity, "building a space away from normal activity, where people trust each other and agree to behave by a different set of rituals, is key to enhancing a team's creative capability."[2] These environments are designed to be multifunctional yet support specialized activities. The multi-functional spaces and specialized environments examined in the three cases in this chapter are ideal for group creativity that fosters a platform for innovations.

The cases

DFM

Launched in 2011, DFM is a mental and physical platform devoted to interdisciplinary project-based learning. DFM is located within Swinburne University of Technology, Melbourne, Australia and it can be "defined as a triage of nodes that intersect with university and with industry in a community of practice."[3] DFM bring together students, academics, researchers, and corporates in order to create a new working and learning culture, and transform university-business collaboration for research and development impact. DFM is a spatial, physical, and virtual environment that facilitates and supports collaborative practices through temporal boundaries. The physical boundaries are by definition "any tangible structure that defines territoriality and space,"[4] while the virtual boundaries are the virtual and digitalized space together with the inhabitants of the environment who form and construct the interplay between the two spaces. Both the physical boundaries of the DFM's spatial location within Swinburne University of Technology and its virtual connections to the Design Factory Global Network (DFGN) and external collaborators classify it as an

environment with temporal boundaries. Temporal boundaries are "based on both tangible and intangible boundaries, symbolizing an event in time, place or space."[4] DFM is classified as an environment with temporal boundaries as it is a non-static environment that is in constant flux.

PMQ, Hong Kong

PMQ provides a platform for the collaboration of disciplines. It provides the opportunity for the local and international design communities to collaborate and innovate through its multi-disciplinary business model, financed by both industry and educational projects. These projects are sponsored and/or promoted by an organizational structure and collaborations such as those with Hong Kong Design Centre, Hong Kong Polytechnic University, Hong Kong Design Institute, and the Vocational Training Council. Located on Aberdeen Road, in Hong Kong Central, SoHo design district, PMQ initiates physical retail and exhibition activities in order to attract the local community. PMQ's open platform includes retail stores, offices, design studios, restaurants, pop-ups, flagship retail stores (ranging from stores for paint to jewelry and fashion), design and architecture, and educational areas. "PMQ provides opportunities for local designers to exchange ideas and interact with their overseas counterparts and to develop synergies through various forms of collaboration."[5]

Telstra HQ

Telstra is a telecommunication and technology company that originates from Australia. Telstra has "around 36,000 employees offering consumer, small business and enterprise services."[6] In 2012 Telstra implemented the initiative, "'Future Ways of Working (FWOW®) – a new more flexible and collaborative work ethos and environment."[7] The implementation of FWOW required Telstra Sydney HQ, located within the commercial center of Sydney CBD, to be redeveloped. The initiative required Telstra to re-envisage the workplace and include a "mix of desk spaces, quiet rooms, scribbling walls, meeting rooms, benches, libraries, brainstorming pods, immersive video spaces and casual comfort zones."[7] This redevelopment and re-envisaged workplace model for Telstra facilitates an activity-based work ethos that emphasizes collaboration. Since the implementation of FWOW and the redevelopment of the Telstra Sydney HQ, Telstra has reported (information gathered from a 2014 study) that there has been a "22% increase in collaboration [and] 81% increase in interactivity with colleagues without an appointment"[7] within Telstra Sydney HQ.

Open physical spaces, open collaboration

Each discipline brings its own perspective into any project, which only enriches the collaborative experience and the project itself. The open collaboration between different disciplines is reflected in the open collaborative environments at all levels: physical, interior, exterior, and virtual. According to French theorist Henri Lefebvre, who specialized in exploring ideas about how humans form and produce the spaces they inhabit, inhabitants are both the co-creators and appropriators of the space they occupy.[8] The inhabitants of a space jointly form, build, and create their surroundings, and they have the ownership to appropriate their surroundings, adapting their surroundings to meet their needs.

The social context of environments allows for this appropriation and ownership of the space. This open occupation offers the opportunity to create flexible working and learning environments and a sense of community amongst the occupants. Open environments lead to open collaboration. University environments such as DFM are evolving to adapt collaborative industry practices in order to encourage such open collaborations across university disciplines. Conversely, work environments like PMQ are evolving to include research-based university practices as part of their business model. The practices of PMQ are realized through educational activities and collaboration with leading universities such as Hong Kong Polytechnic University. Equally, in Telstra Sydney HQ the FWOW initiative—as articulated by the present director for Collaborative Practice Telstra, Gwilyn Funnel—focuses on how the company can transform in order "to be much more collaborative, [an] innovative environment and really improving how we cooperate as an organization both internally and with our customers and with our partners."[9] This shift has highlighted the importance of both the physical and virtual environments of Telstra Sydney HQ and how collaboration occurs, both inward looking and outward looking.

Openness is reflected in the layout of the physical interior, the exterior, and the virtual environments of DMF, PMQ, and Telstra Sydney HQ, which are flexible and adaptable to how people occupy them. The environments also each represent their culture and community, which influences the perceptions that people have towards them. These types of co-creative environment invite collaboration and integration. Lefebvre says that spaces provide "a message"[8] and it is the role of the occupant within the space to read and interpret those messages, as also discussed in the previous chapter of this book. A flexible and adaptable space is open to interpretation by providing messages and cues to the occupants, allowing them to co-create. Various prompts, and visual and verbal cues, can encourage the desired behavior. In the context of interior architecture, prompts traverse spatial design. The boundaries that define a working and learning environment are formed by: the artifacts; the fit out of an environment, which includes furniture, lighting, and color selection; the prompts that act as wayfinding cues or provide messages that direct the operation and usage.

Visual messages to support collaborative practices

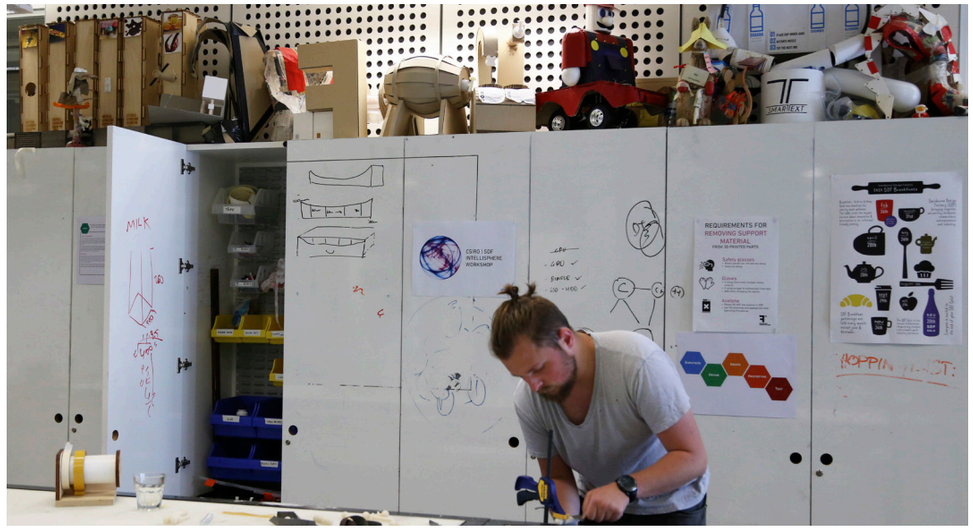
The prototyping space at DFM is an environment that is open for collaborative practices and is malle-

able and flexible in design. This space is specifically designed to facilitate the rapid process of innovation whereby ideas can be quickly realized through rough and soft prototypes and models. It is an environment that allows ideas to be formed quickly and then altered and refined through the process of making. Though replicated throughout DFM, the visual messages and prompts within the prototyping space serve as an example of, firstly, how an environment provides messages towards the appropriation of the space and, secondly, how physical and virtual environments can be intermingled to aid co-creation and innovation practices.

The physical and virtual environment of DFM consists of visual messages, which are reinforced by the open design culture present within this international collaborative platform. It is through the occupants of DFM and their interpretation of these messages that they co-create both the physical and virtual environments to suit their purpose. The physical environment of DFM comprises both temporary and permanent artifacts that provide messages to the occupants about the flexibility, adaptability, and collaborative nature of DFM. The picture on the right page shows the DFM prototyping space, which contains visual messages for collaborative activities and prompts that can aid in innovative practices. Within the prototyping space, the cabinetry is constructed with a whiteboard finish, acting as a platform for current and past occupants of the environment to use as a communication tool. It is a platform upon which occupants can sketch their ideas and leave messages that are traces of their occupation and can be enablers for innovative practices. This is because these traces of occupation can act as conversation starters, provide a platform upon which people can build ideas, and also they can make a concept or idea tangible through the act of documentation.

When occupants can leave traces of their work, it allows them to begin taking ownership of the space as they themselves are represented in the environment. There is for example an arrangement of prototypes spread across the shelving and the prototypes act as visual messages about what has been constructed in the space or what occupants are currently constructing. These remnants of past and current work are strategically and spontaneously left throughout DFM and in particular in the prototyping space. They are reminders of what has happened and what can occur within the environment, therefore acting as visual prompts between the past and current occupants of the environment and as conversation starters between occupants.

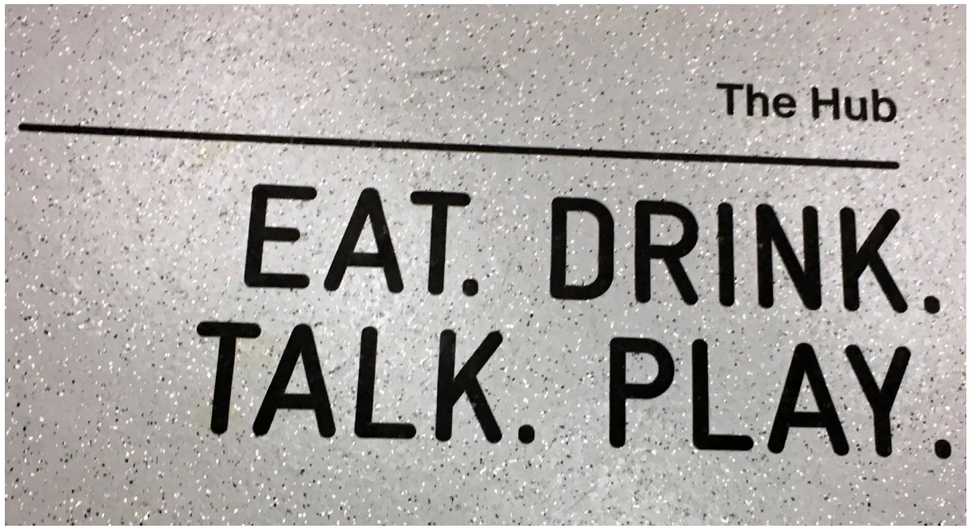
The inclusion of accessible materials within the DFM Prototyping Space also provides visual messages. The placement of materials and their accessibility provide a message of openness and allowance. Having materials on-hand and in a place of easy access communicates to occupants that the items are there to be used, that they are there for the benefit of the occupants and their projects.



The DFM Prototyping Space: An environment can provide a message to its occupants. These messages act as prompts in relation to the occupation of the space but are also messages between the current and past occupants of the environment.

Prompts used to change practices

In the case of Telstra Sydney HQ, the prompts positioned within the interior design are both subtle and overt. The subtle prompts, such as the typography on the floor and the naming of spaces, provide clues as to what types of activities are encouraged within the space. For example, the naming of The Co.Lab environment and its tagline ideas happen here reinforce the purpose of the environment to its users. The message suggests the types of occupation of the space and activities conducted inside the space. The purpose of The Co.Lab environment as a space for collaboration and idea generation is further reinforced through overt prompts from the furniture. The furniture in The Co.Lab is flexible, movable, and fun, directing possible activities, including creative participation and collective teamwork activities. It is evident that there is no provision of fixed furniture, hence a distinct message is conveyed that there are no designated occupants and no one owns the environment.



Telstra Sydney HQ: Naming and branding an environment provides subtle clues towards the occupation of the space.

Telstra Sydney HQ – The Co.Lab: Flexible and playful furniture provide overt cues towards the occupation and adaptability of the environment.

Traditionally the word retreat is not commonly associated with corporate culture. However, Telstra Sydney HQ has adopted the term and the connotations of the word within their corporate environment. The name "The Retreat," which is accompanied by the tagline go well, stay well, reinforces healthy behavior and allows workers to regenerate and reflect, which is an important phase of innovative practices. The time to step away from collaborative activities and to analyze and reflect individually provides the quiet, still time where innovation can continue to be nourished. To facilitate the reflective requirements of innovation, the spatial design of The Retreat does not represent a traditional corporate working, desk-based environment, but instead it incorporates elements that are representative of a library or a café.

Embedded within the naming of The Co.Lab and The Retreat is also an assumption about the types of work practices Telstra encourages. The subtle and overt prompts that are incorporated into Telstra Sydney HQ are key elements to communicating Telstra's FWOW initiative. The implementation of an activity-based work infrastructure requires the environment to be responsive and support the new model of collaborative working. Telstra is aiming to shift the working norm. The prompts in the physical environment immerse the staff of Telstra in new and possibly unfamiliar ways, encouraging their work community and engaging with it.

Telstra Sydney HQ – The Retreat: An environment that promotes reflection and individual work.

Communicating connections through a staircase
The location of PMQ in Hong Kong is iconic—Central SoHo—an area known for its prestigious cultural and historical diversity as well as its rich art and design culture. PMQ reflects this identity. This diversity is narrated through the various historical traces, such as the entrance, the staircase, and traces of the original buildings. The location of PMQ makes it accessible to the public and, similar to DFM and Telstra Sydney HQ, the entrance to PMQ was designed in order to encourage instant transition from the street, inviting the locals to take part in the cultural activities without any intimidation. The historical staircase within PMQ acts as important prompt. The rammed earth staircase creates a contrast against the new glass staircase behind it, and reveals part of the historical transformation of PMQ from the residential quarters of the junior police to studios for emerging designers or offices.

PMQ utilizes the history of the site as a prompt to the occupiers and to visitors. Walking tours in the Underground Interpretation Areas are organized by PMQ in order to educate people on the history of the building and in so doing to create a museum of the old site. At the same time, the museum is revealed as part of a walkway through the retail section of PMQ, where a section of the old foundation of the building is shown as archeology. This treatment of the old building as archeology that is encountered around the modern retail area is similar to the treatment of ancient Greek archeology in the Acropolis Museum in Athens, designed by Bernard Tschumi. However, what is important to note is the location of the open exhibition. Being located within the central core of the PMQ building and on the ground floor it is open for PMQ occupants to experience and be inspired by. But its location also makes it open for both the wider Hong Kong and global community to experience.

The staircases at PMQ become another platform to highlight the art culture that is embodied within the environment.

The central core of PMQ, with its veranda-like structure, provides an opportunity for the exhibition space. There is a constant interconnection between the PMQ environment and the PMQ culture of design, creativity, and innovation. The environment of PMQ provides constant prompts and cues towards the history of PMQ and also towards its future as an environment where design, creativity, and innovation are its core business. The surfaces and the built environment of PMQ are constant prompts towards the PMQ mission. The stairs are an example of how PMQ has integrated its creative culture and design into the physical structure and built environment in order to reinforce the vision of the organization.

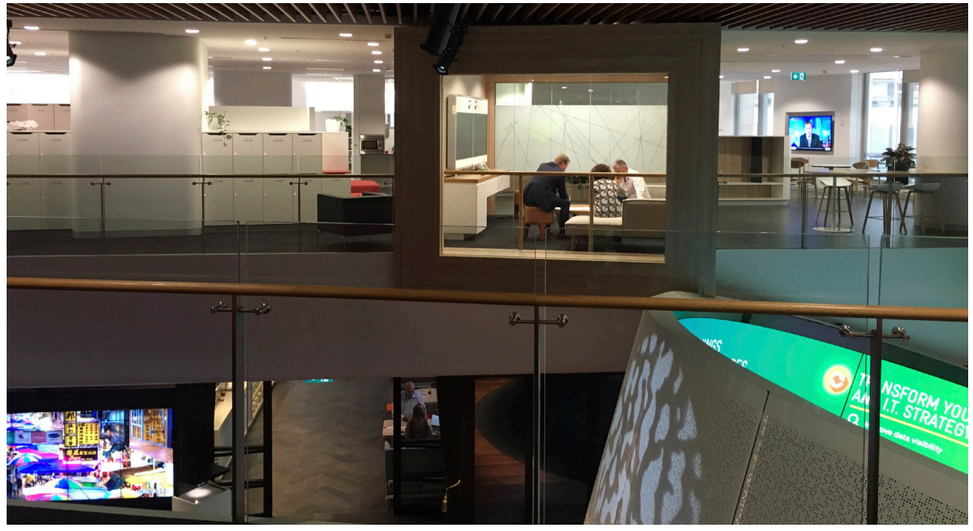
Physical and virtual boundaries

Collaborative and co-creation environments encourage, promote, and inspire the interaction of ideas and disciplines through the flexibility of spatial design. This exchange of ideas occurs across physical and virtual boundaries. However, technology has blurred the boundaries between these environments. This blurring has changed workplace environments between the traditional physical walls, which has simultaneously shifted the ways of working, teaching, and learning in both corporations and universities. Although DFM, PMQ, and Telstra Sydney HQ are three distinct entities with different purposes, the mission to engage and collaborate across multiple environments and platforms, from the analog to the digital, drives their associated activities and is derived from a desire to create and encourage openness to a culture of design and co-creation. Through virtual extensions, DFM, PMQ, and Telstra Sydney HQ are able to work on global projects influenced by industry practices that have expanded their projects beyond geographical boundaries. The interconnectivity of the physical and virtual environments highlights the different modes of collaborative multi-disciplinary platforms that are occurring between local and global corporations, universities and community partners. The open business model of PMQ encourages the integration of local and international educational and industry interventions, while the use of Skype as a teaching tool in DFM invites co-creation and the blurring of boundaries between physical and virtual learning spaces. In Telstra Sydney HQ the integration of physical and virtual structures provides an opportunity to traverse between different working models and the delivery of content.

The virtual spaces of the three cases have altered the importance and the role of the physical environment. In DFM, virtual spaces have allowed individual learning to take place virtually and globally as well as within the traditional studio environment. Similarly, in the other cases the role of the physical precinct has integrated working, retail, and learning within the physical and online environment that invites community involvement. Technology has been integrated into the working practices, allowing for both local and global collaboration. This means the role of these types of collaborative spaces is rapidly shifting towards providing an environment where students, academics, and corporations can engage physically, work collaboratively, and learn through social connection. The number of these kinds of spaces is fast growing, with corporations and university campuses providing more environments that allow for flexible, communal working and learning practices.

DFM, physical and virtual co-creation.

PMQ, blurring the boundaries between work and play. [10]



Telstra Sydney HQ, an innovative precinct between the physical and virtual corporation.

The integration of physical and virtual environments can be manifested in multiple ways. The ubiquity of virtual environments and possibilities for online communication have moved many previously physical activities to online environments.[11] Activities that take place in virtual space are "bound by technology and unbound by the convenience and flexibility offered by freeing activities of physical locations."[11] Whether taking the form of virtual windows, online platforms, or cylindrical screens, these blurred boundaries between physical and virtual space extend the boundaries of their communities.

A virtual window expanding the boundaries of a physical space

DFM occupants are not a static group but an ever-growing global community where members enter and return to industry, and work or study overseas and within other design factories. A virtual window in DFM provides a point of connection and link between DFM and the DFGN or any other external contributor. Through the virtual window, connections can be made and ideas and prototypes can be shared, expanded, developed, and refined in collaboration. The virtual window provides the opportunity to link up with remote community members. Furthermore, work and education today rarely occur within the boundaries of a nine-to-five day or within a fixed environment—instead, the boundaries between work and home hours and environments are becoming intermingled due to technology.[12] It is through forms such as virtual windows that working communities that vary in numbers and in geographical positions stay connected, collaborate on projects, and innovate together. The interplay between the physical DFM and the virtual DFM is a constant. Occupants across the DFGN as well as external contributors of the community can connect to the physical environment of DFM, as through technology the physical environments are connected visually to the wider world, opening up collaboration opportunities.

DFM Prototyping Space: The interplay between the physical and the virtual environments

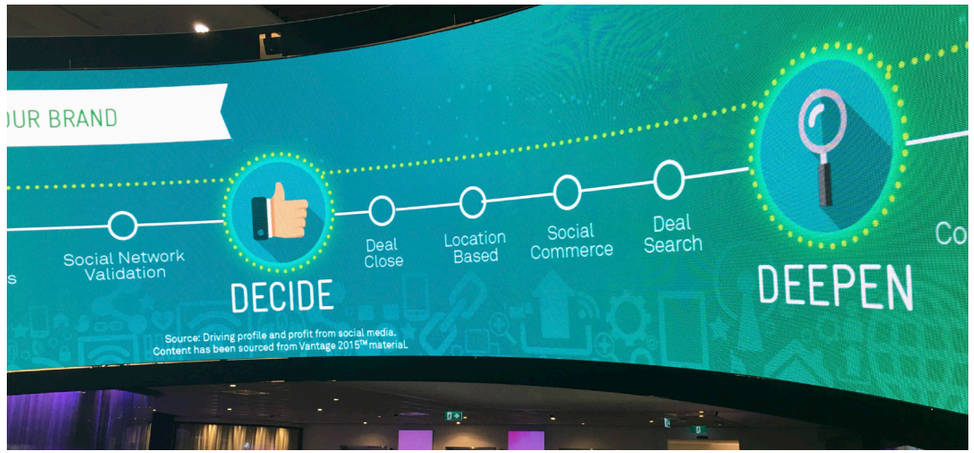
An online platform connecting local designers to global partners

Similar to DMF, PMQ uses an online platform in its effort to support the collaboration of design disciplines. The online platform is used to promote and facilitate its physical activities and to connect with the global community, thus increasing collaboration and co-creation. PMQ runs physical and virtual events helping the community to connect to different parts of the world. This blurring of activities increases the awareness of Hong Kong's local art and design community, promotes innovative activities, and invites future collaboration between global partners in different continents. Without technology, this partnership would be impossible. The physical and virtual activities become inseparable and vital to the sustainability of the mission statement of PMQ: to promote and assist local emerging designers through co-creation activities.[5] Past exhibitions at PMQ have been an open invitation to the global art community that wished to collaborate with PMQ and its educational partners. Such physical exhibitions were then uploaded on their online platform for further promotion and further collaboration with the industry and educational partners, thus blurring the boundaries between the physical and the virtual, between education and business.

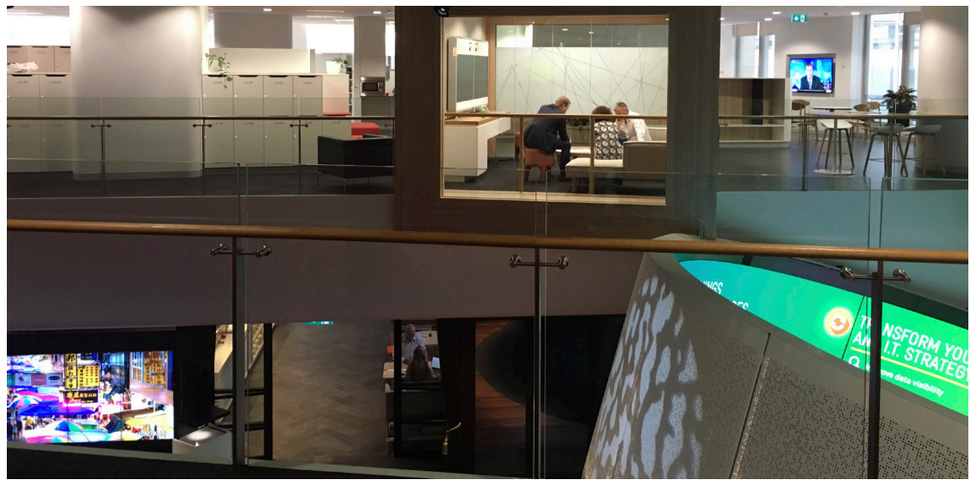
Technology supporting work practices within the built environment

The integration of the physical and virtual structures within Telstra Sydney HQ provides the opportunity for Telstra employees to traverse different working models and deliver content both internally and to Telstra's clients. Technology is integrated into the practices of Telstra Sydney HQ, providing collaboration opportunities between Telstra and their partners, customers, and suppliers. Technology provides Telstra with the capabilities to "engage with one another in more powerful and productive ways, including using the power of the crowd."[13] Technology has been integrated into the built environment. An interactive cylindrical digital structure is prominently positioned within the entrance of the Customer Insight Centre of Telstra Sydney HQ. The cylindrical digital structure is an introverted 360-degree video ring named the Insight Ring. The Insight Ring is a "9-metre high audiovisual installation that delivers insights into a customer's industry and importantly, Telstra's own views and insights into the 13 industries it covers."[14] The Insight Ring acts as a communicator between Telstra and their customers. The physical and digitalized structure assists Telstra in communicating to their customers through both physical and digitalized experiences, allowing them to "demonstrate its understanding of that customer's industry, their issues, their opportunities, their own customers."[14] The inclusion of digital structures such as the Insight Ring provides platforms for Telstra to connect and engage with their customers and to highlight the tech and innovation capabilities available through Telstra. Telstra, being a technology-driven organization, have been mindful of how to best present their capabilities to existing and potential customers. Due to the core business of Telstra being telecommunication and technology, it is important that technology is integrated and highlighted within the physical environment of Telstra Sydney HQ. The mechanics of the Insight Ring emphasize the integration of digital practices within the built environment of Telstra Sydney HQ. The integration of digital elements into the built environment is scalable, from the large-scale Insight Ring to various scaled screens

that are used for in-house collaboration. What is important is that the digital features do not override the built environment but act as collaborators, seamlessly forming and informing the environment. Technology, people, and the environment coexist, creating a dynamic environment and blurring the division between corporate, educational, and social environments.



Telstra Sydney HQ Customer Experience Division:
The interplay between physical and virtual environments.



Telstra Sydney HQ: The interconnection between physical and virtual environments.

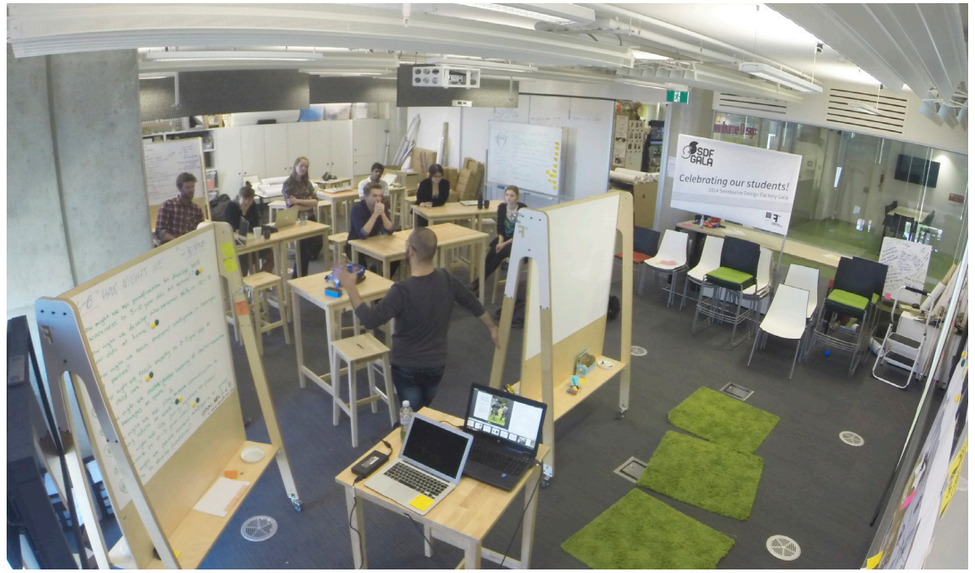
The adaptability of interactive spaces: Three ways of implementing a multi-functional space

Technology provides flexibility, giving rise to the mobile office and nomadic modes of working and learning. It is now possible to work from nearly any location at any time. This revolution is taking the workplace outside the traditional boundaries of the bricks-and-mortar corporate environment. A global survey of co-working users conducted by Deskmag found interaction with others, flexibility in working hours, and an environment supporting serendipitous discoveries to be the three most important aspects of co-working spaces.[12]

In many companies, the physical workplace has been reconceived: private offices and cubicles have been removed and space has been opened up for more "flexible, communal, and transparent workspaces."[11] This is evident within Telstra Sydney HQ. The interior environment is designed to reinforce serendipitous connections between co-workers and an activity-based working model. This design is underpinned by the concept that activity-based work gives individuals permission to select the ways in which they wish to work; this however requires individuals to be mindful and aware of the organizational work ethos and its mechanics in order to then select the best avenue to take to commence and complete an activity. To respond to the activity-based work, specific environments within Telstra Sydney HQ are designed to be away from the work desk in order to facilitate different activities and modes of work. The company has redeveloped their working environment to include retreat spaces—as well as co-working spaces, kitchen and lounge spaces—alongside the traditional open plan work zones and meeting rooms. The inclusion of activity-based working environments and social interaction-driven spaces mirrors the interior typology of some of the leading global corporations such as IDEO, Apple, Google, Airbnb, Facebook, and Spotify. These corporations and the environment of Telstra Sydney HQ are examples of transparent interior typology whereby an "open layout that spurs collaboration"[15] is supported and facilitated. The model of thinking around how interior environments can facilitate collaboration, different models of working, and activities with corporate spaces has altered the culture of working. The interconnectedness of the work environment, people, and technology constitutes this dynamic work practice. Technology infrastructure supports the running and the operation of the environments. Also, Telstra Sydney HQ relies upon a booking and information system that informs the users of the intended purpose of the space. Technology reinforces self-management and responsibility for the work activities. For example, The Co.Lab space is promoted as a collaborative workshop for idea development activities and thus can be booked for short periods. In comparison there are "The Project Rooms" that are intended to facilitate and support project activities (from construction to completion) with longer completion cycles. Booking lengths enable cohesive projects to develop and incubate, providing a consistent location without interruption. In contrast The Retreat is an open space that is not bookable. The structure and division of environments both in design and occupation are built to support and facilitate the open typology of Telstra Sydney HQ.

Within DFM the environments can be adapted and changed as per the requirements of the occupants at the time. To facilitate easy change, the furniture is moveable, either by being placed on casters or by being light in structure. This feature of the furniture extends into the main studio room, which contains no fixed furniture. This means that the studio space, like all the other spaces, can be configured to host a lecture or a workshop, be an extension of the prototyping space, or function as an exhibition environment. This flexibility of layout that has been created with furniture provides great advantages to the occupants as it allows them to form and appropriate the space to work for them and their collaborative teamwork instead of against them. It is a common occurrence within university environments for spaces to be fixed and branded as a lecture room, studio room, or classroom. The branding of these environments and the inclusion of static furniture prohibits group work and the collaboration process. This occurs because occupants of these traditional university environments are disinclined to appropriate the environment and adapt it for the purpose of the activity at hand and instead take the environment as a given and also act according to the cues in the space. The subliminal message presented within these conventional spaces is that it is an environment that must remain static. Occupants pack up and leave the environment as it was when they entered, thus leaving no trace of their occupation. DFM encourages the opposite: the occupants are encouraged to leave a trace of their occupation as it is through their traces that further collaboration and innovation may occur by building on and evolving previous ideas.

The DFM Studio Space



The environment can be adapted and changed as per the requirements of the occupants

Within PMQ different activities co-exist in close proximity, which provides opportunity for collaboration and innovation, and brands the environment as a space of activity. The diversity of these activities leads to open collaboration and spatial transformation. Activities include retail on the bottom floor, a large foyer for exhibitions and events, in-residence studio areas for emerging local designers, and multi-purpose areas on the top floor for educational use as well as studios and industry offices. The areas prompt the following types of activities: the open verandas of PMQ provide environments where the occupants of PMQ can showcase their work; an open foyer prompts more art and exhibition activities; the typology of the first floor prompts retail activities. Each area invites visitors and occupants to perform a different activity, co-creating an open and dynamic collaborative space or spaces. An open and expansive footpath provides the opportunity for inhabitants to view the activities within PMQ while recessed windows and balconies provide the opportunity for inhabitants of the space to catch glimpses into the floors and view the activities that are occurring. The open platform acknowledges the co-existence of various activities and inhabitants at play.

PMQ: Industry meets the university through collaborative work practices. [16]

Conclusion: Deconstructing the boundaries between the physical and digital

Future ways of working and learning have led to a shift towards collaborative and co-creative modes of activities. However, this change in expectations has required working and learning environments to be reactive towards active online and physical collaboration. The shift towards collaborative practices has also highlighted the need for environments that are multifunctional. As viewed through the three cases of DFM, PMQ, and Telstra Sydney HQ, environments can facilitate differing modes of working, learning, and other activities within a single space. In DFM, the prototyping space is a casual meeting area as well as a learning environment that facilitates the making of physical artifacts and is accessible to the local and global community of DFM through a virtual window. The PMQ entrance is accessible to the local community and the open courtyard, where activities such as exhibitions and events take place, is made accessible to both the local and global community through online channels. In Telstra Sydney HQ the inclusion of retreat spaces and co-lab environments reinforces the FWOW model for employees.

Physical environments are already adapting and are integrated with virtual environments because of the need to be global. Work and learning activities, physical and online environments, and local and global spaces are blurred, pushing the boundaries between these realms and leading to the emergence of new types of collaboration. Global collaboration enabled by technology is continually questioning the boundaries between physical and digital environments and changing the future.

TACKLING THE CHALLENGE OF VIRTUAL CONVERGENCE

Prototyping experiences to enhance distributed collaboration

Tuuli Utriainen
Joona Kurikka

Key points

- Design projects are increasingly executed in a globally distributed fashion utilizing different types of online environments.
- Adding the global dimension to design projects does not only bring forth benefits and novel opportunities but also novel challenges for the design teams separated in time and space when compared with face-to-face collaboration. These include (but are not limited to) the coordination of teamwork, communication, decision-making, and feeling content about the outcomes of the work.
- In a study of distributed student design teams, convergent activities that require finding consensus and agreement within the team seem to be the most challenging.
- Rather than merely instructing student design teams about the problems of virtual work it is suggested to provide them a concrete experience on the challenges to better prepare them for distributed collaboration.
- For efficient virtual work, adequate time should be allocated for communication, focus placed on empathy between the team members, and extra attention paid to the activities of synthesis and decision making

Virtual teams' pains and gains

One of the most important prerequisites for successful product design and innovation outcomes is incorporating multiple points of view. These typically include those of marketing, user, customer, engineering, and industrial design and future forecasting, along with many others. The more diverse mindsets you can integrate into your design process, the better the outcome is likely to be. This interdisciplinary composition has recently been promoted forcefully by design thinking institutions such as the design agency IDEO and the d.school at Stanford University, which mentions radical collaboration as one of their d.thinking mindsets[1].

In order to expand the points of view incorporated in the design team beyond the field-based mixture, having a part of the team operate in a different culture can offer multiple benefits[2]. For example, multiple cultures force the team to be able to express the concepts and ideas they develop in a clear and understandable manner, so that they translate through the barriers of language and local discourse. This helps to clarify what is being proposed from the start of the project to the end. Also, having need finding, benchmarking, and user research results from different global locations increases the diversity of the feedback to the project and helps make the designs more robust and relevant. Furthermore, when aiming to launch a product or a service for a global market, having multiple local starting points also supports reflection and decision-making.

Fortunately, design projects can be now executed in a globally distributed fashion through the use of online environments. Online environments allow a design team to work immersed in various cultures over several time zones in a virtual constellation. Virtual teams are teams "in which members use technology to interact with one another across geographic, organizational, and other boundaries" [3]. This means that teams can operate virtually, even within the same city, the same building, or the same room—spatial separation between team members does not need to be substantial for virtual work.

The challenges of working remotely

Adding the global dimension to design projects is very rewarding but also creates new demands that can be very different from "traditional," co-located, and synchronous projects[4,5]. The virtual working environment does not only bring forth novel opportunities but also novel challenges for the design teams separated in time and space when compared with face-to-face collaboration. Compared with co-located teams, virtual teams experience more difficulty working together. The challenges include (but are not limited to) the coordination of teamwork, communication, decision-making, and feeling content about the outcomes of the work[4-6].

Computer-supported distributed collaboration has been practiced in engineering design for decades, with the advancing technology and faster network connections creating more and more alternatives for distributed team collaboration. However, the number of alternatives also presents a problem, especially for newly formed teams that do not have prior experience of the collaboration tools they are about to start using. Some research has even indicated

that the newness of the technology can cause more challenges to teamwork than all the other factors in a newly formed team[4,7].

In addition to the technical challenges, coordination and communication are major issues affecting the performance of a distributed design team[4]. Compared with their face-to-face counterparts, virtual or computer-mediated teams have been found to view their discussions as more confusing and less satisfying, they spend more time making decisions, and they feeling less content with their outcomes[6].

Fundamental design activities and distributed collaboration

Obviously, a design project contains very different types of activities, which can be differentiated by, for example, whether they are divergent or convergent in nature. It is thus useful to reflect on what type of activities there are and what implications working remotely has for the different types of activity. Drawing heavily from the work of Lindberg et al. [8] and combining it with other literature on design thinking, we have synthesized a framework describing nine distinct design activities, as depicted below .

In order to understand how these fundamental and distinctive design activities differ in an online environment (as opposed to in co-located teams), we studied the experiences of globally distributed student design teams. We asked students from different fields who were participating in a global design project to evaluate how difficult different design activities were for them in both a co-located environment and an online environment.

DESIGN ACTIVITY	DESIGN ACTIVITY DESCRIPTION
(Re)defining the problem	Working on the problem space and redefining what the team is solving
Grasping external knowledge	Expert interviews, research, needfinding and benchmarking.
Knoledge pooling	Sharing results with the team, putting up gathered material on walls whiteboards, saturating information.
Synthesis	Working with the gathered materials, getting out key insights, seeing patterns and making sense of what has been done so far.
Making decisions	Selecting next steps with the team, converging, path selection.
Ideation	Coming up with multiple solutions, flaring, divergent thinking, brainstorming.
Concept especifying	Focused work, concept development, getting from low resolution to a higher resolution.
Making it tangible	Prototyping, realizing, building.
Testing and user feedback	Testing concepts and prototypes, gathering feedback, learning from the prototypes.

In our investigations, the 37 students experienced online work to be clearly more difficult than co-located work. Most importantly, they felt that all of the aforementioned distinct design activities were more difficult to perform remotely. This highlights the holistically problematic nature of virtual design work and indicates there is a strong need to develop better tools to bridge this gap. The rankings of the design activities remained similar over time during the project. This indicates that the same activities are difficult throughout and do not dynamically fluctuate depending on the phase of the project.

The difficulty in virtual convergence

When working remotely the most difficult activities identified in our study were making decisions, (re) defining the problem, and concept specifying. These most difficult activities seemed to be convergent in nature—they require finding consensus and agreement within the team. Decision-making has also been identified as especially difficult in previous research5. Intuitively one might think that the more creativity-intensive divergent activities would be, the harder the act would be to perform virtually. Why do the convergent activities seem to be especially difficult then?

Not surprisingly knowledge pooling, which happens effortlessly when a team is working around the same table, was experienced as the easiest activity when co-located. However, in a remote setting it was experienced to be harder than many of the other activities.

This effect can bleed into other design activities as well. When looking into possible correlations between the activities, a strong link was found between knowledge pooling and synthesis. A strong correlation was also found between synthesis and making decisions. This could mean that, since knowledge pooling becomes much more difficult in a virtual setting, it also affects the ability to synthesize this knowledge into shared insights. This, in turn, might lead to increased difficulty in making decisions. This would imply that in order to aid decision-making in virtual teams, better knowledge pooling tools are needed to treat the root cause of the difficulty.

Another activity that was more difficult for the teams in a remote setting was making it tangible. This might also affect knowledge pooling, as making the shared knowledge tangible and participating in joint problem solving is one of the essential mechanisms of building shared understanding within a team[9], which is in turn essential for knowledge pooling and interrelating with the team[10].

Disclaimer—*easy* does not necessarily indicate *good*

Though making decisions and (re)defining the problem were experienced as difficult activities, it might be that they are difficult for a good reason. According to Don Norman, they are the key activities in design[11]. Experienced difficulty might be an indicator of the students wanting to make the best possible decisions and thus being willing to spend significant time and effort on these critical activities. Describing the uncomfortable nature of not knowing or not deciding, Larry Leifer and Micah Lande from Stanford University[12] state that: “The ambiguity with which projects are defined is something that students find unsettling and most certainly are not used to. As engineers, they have been trained to eliminate ambiguity, not preserve it, and to minimize any existent uncertainties.” Operating outside of one’s comfort

zone is known to be unpleasant and to feel difficult, but it also offers a chance for growth and discovery.

Tackling the virtual challenges head-on

To conclude, in addition to all the potential benefits, virtual working environments also propose significant challenges for distributed teams. There is still work to be done in order to alleviate the experienced difficulty. Meeting all the remote members face-to-face has been shown to be one of the best ways to mitigate the negative effects that technology and distance can cause to the group performance[5,13]. In addition to countering the negative effects, early physical meetings are also likely to increase the overall effectiveness of the following online collaboration[14].

Taking all of the above into account, we decided to develop an exercise simulating the virtual working experience that would allow design teams to explore the challenges presented by the virtual environment while working co-located at the beginning of the project. The set up and results of the exercise will be described next.

Challenge-Based Innovation at CERN and the Container Challenge

To test how we could convey a light version of the experience of virtual work for design teams, we came up with the Container Challenge. Rather than telling our student design teams about the problems of virtual work (transcendent knowledge) we wanted to give them an experience they could really relate to (experiential knowledge).

We have implemented this challenge twice as a part of Challenge Based Innovation (CBI), a globally distributed design innovation course coordinated at IdeaSquare in CERN that brings together participants from universities and institutions around the world. CBI is a six-month project course where participating, multicultural, and multidisciplinary student teams are given society-driven challenges, along with access to CERN technology and expert mentors, in a pursuit to redefine and develop solutions to these challenges. During the project the students go through a design thinking process including phases of intensive need finding and benchmarking, solution prototyping, and user testing. The design teams spend about one month of the project co-located, working together in Geneva over two to three periods, and five months distributed, with team members working in their home institutions. Both of these working stages evidently have their own specific challenges. In order to facilitate this work, we have studied the experience of the team members, which we discuss here.

We run the Container Challenge during the global kick off of the CBI course, where all the students travel to CERN to meet and work with their teams for the first time. The chance to experience virtual work has seemed to serve as a good reflection and discussion point. Even in this short amount of time the students seem to have understood communicating what was being done as a separate layer from the doing itself. As one of the students concluded, "I learnt that communicating and doing should be split into two separate parts. It is sometimes hard to do everything at the same time." This naturally called for an extra time investment that was felt very laborious compared with sitting around a shared table.

Several students experienced that the silent gaps during work might be misinterpreted as not caring about the project or slacking off: "Group members should know that it is silent at the other end because the others are focused on doing." Also, differences in tool usage might result in confusion: "If I don't immediately reply on Facebook it's not because I don't care—I go there only once a day so there might be a delay in my response." There might also be other reasons for a delayed response time due to asynchronous nature of the communication: "In virtual work it takes longer to answer—I want to make sure people understand me and what I mean since they might not ask even if they don't understand me."

One of the non-native English-speaking students stated that using the technology is not the problem but speaking in English can be very uncomfortable. One of the positive effects of the country-based distributed work environment was getting the native language back. The language used was seen to have an effect on a deep level as "Changing the language made working really effective—there were no cultural and language barriers and less conceptual differences." The virtual environment introduced two new channels—text chats and video. Leveraging the additional channels allowed some unheard voices to emerge: "Through writing you could be heard even better than talking."

After the challenge, the students felt like they had achieved common ground for further planning the remote communication—one of the students stated, "I understand that the problems I have studied really exist, not only in theory."

Container Challenge: Applying the experience

Container Challenge is a short exercise that allows design teams to take their first steps into remote working experience while being co-located. The optimal timing for Container Challenge is during the kick off of a global design project when the remote team members meet each other for the first time. By going through a design challenge conducted solely in an online environment, the students are afterwards able to discuss their experiences in a face-to-face setting and they can start tackling the virtual challenges from a common ground.

Preparation

1. Prepare isolated working environments representing each remote "design loft."

We selected a few meeting rooms and containers and named them after the countries our students would be working from. The blue container became Italy, the green was named Norway and so on. Make sure that the distributed sub-teams have no sensory access to the other team's space (they cannot see, hear, etc. what is happening in the other room). There should be an internet connection and power sources in all the spaces.

2. Prepare a challenge the teams will tackle together.

We asked the students to design a poster about their project and deliver it to us in one hour. The tighter the deadline the more stressful (and potentially realistic) the students' experience will be. Make sure, that the challenge is broad enough and will need the whole team to collaborate on it. This will ensure that the critical converging activities are also performed during the challenge.

3. Prepare the virtual work environment.
To set up the online work connections ask the teams to install and share the virtual collaboration tools they are aiming to use during the rest of the project.

Running the challenge

1. Launch the challenge:
Deliver the design teams the challenge you devised and the limitations, including the global communication time and the deadline. Make sure the teams understand that during the challenge the teams are not allowed to meet physically in order to create an authentic distributed work situation.

Limit the time teams have for joint communication in order to make the challenge realistic. This allows each team to have both "local" work time as well as "virtual work time." For example, we limited the communication between different locations to a maximum of 20 minutes of synchronous global working with voice and video between the whole team. The entire challenge took an hour.

2. Split the teams into their respective containers / work spaces.

3. During the challenge move around and observe the teams.
Make notes if you pick up on something you would like to bring out as an example later in discussion.

4. After the challenge, have teams present their deliverables.
Take note of who presents and how the other team members respond to different points of the presentation.

5. Lead a reflective discussion on the experience:
Use the whole experience (working in the containers, what you observed, and what the students just presented) as material and ask how the students felt during the challenge and how their experience differed from co-located work. Ask what surprised them. Ask what felt difficult or laborious and about possible miscommunications.

6. Wrap up:
Conclude what you have heard during the discussion and encourage the teams to devise an empathic, virtual environment work plan taking the experience into consideration.

Conclusion—three takeaways for virtual work

1.Reserve adequate time for communication.
Information does not radiate. Try to learn to celebrate the chance to make documentation and to reflect during your work process.

2.Preserve empathy.
It is difficult to remember that we are all people with our lives, and trials and tribulations, especially when we lack a context and connection to others we work with. Assume the best and try to remember the real person behind the medium.

3.Pay extra attention to synthesis and decision making.
Knowledge pooling, synthesis, etc. are difficult in an online environment, which also affects convergence, making it extra challenging. Give these activities the attention they need and try out different tools and method designs to aid the process.

ORGANIZATIONAL INGREDIENTS FOR CO-CREATION

SECTION IV
ORGANIZATIONAL INGREDIENTS FOR CO-CREATION

Organizational ingredients for co-creation

Co-creation always takes place within some context, typically within and between organizations. While organizations themselves as entities do not collaborate or co-create – rather these activities are always realized in the interactions of people – the organizational context guides the behavior and actions of the people. As a result, it is important to align organizational strategy, culture and practices to support and facilitate co-creation as an activity.

Development is a game of many; typically there are several parties and stakeholders involved, as a complex challenges refuse to be contained within a single disciplinary framework. As Karl Gunnar Myrdal, a Nobel Prize laureate in Economics, has reportedly put it; "Problems do not come in disciplines"[1]. Various technological breakthroughs and innovations have resulted from combining knowledge and ideas from seemingly disparate fields, sometimes seemingly by pure chance[2]. However, more often than not, there is a mediating influence present, such as deliberate breakdown of disciplinary, departmental or hierarchical barriers or an organizational culture that encourages exploration and out-of-the-box thinking. Both large-scale innovation ecosystems composing of various different types of operators as well as single organizations encompass diverse interactions between diverse collaborators. What kind of interaction between people is desirable to unlock innovation and co-creation, and what does this interaction require of them, and what does it require from the organization? How does an organization transition towards a culture of co-creation and promote continuous learning and development towards the desired state?

Aiming to provide insight into these questions, this section explores some of the organizational antecedents of co-creation and means to support fruitful collaboration and co-creation within and across organizations. Miko Laakso, from Aalto Design Factory, starts the section by discussing the helping behaviors and perspective trades that form the foundations of collective creativity, illustrating some of the organizational approaches adopted at Design Factory to support creative interactions and serendipitous encounters. Lotta Hassi from ESADE Business School and Satu Rekonen from Aalto University continue by explicating what experimentation-driven projects require from the people involved, ranging from individual to team level as well as the needed managerial support. After all, experimentation differs fundamentally from the dominant planning-driven approaches in organizations.

Moving on to a level of organizational units, Maria Clavert, a pedagogical expert and researcher at Aalto Design Factory, sheds light on how the constant learning required in development can be supported. She presents Aalto University Design Factory as a learning laboratory, and depicts some of the ways we have found effective in supporting organizational efforts to learn. Finally, Pauliina Mattila and Carl Turner from Swinburne Design Factory adopt an ecosystem view to innovation and co-creation, discussing diversity as a key factor in thriving innovation ecosystems and highlighting the benefits and challenges associated with it. Taken together, these four chapters highlight the importance of having both diversity and support at hand on multiple levels, whether looking at how an individual or an entire organization can successfully engage in co-creation. The chapters draw out the implications that adopting passion-based co-creation poses on how we organize and weave together work in our organizations.

International Design Factory Week as a vehicle for promoting connections, culture and practices

The Design Factory Global Network has grown to encompass twenty members spread around the world far from each other and in different time zones. As the goal of the network is – in addition to sparking and maintaining concrete collaboration – share experiences and jointly develop the DF culture and ways of working, the physical divide obviously poses challenges. International Design Factory Week (IDFW) is the most important annual opportunity for the DFGN members to meet, share experiences, reflect, and plan for collaboration. Every year the week is organized by a different Factory, offering the opportunity to learn more about the hosting organization.

There are some key *"soft" reasons* for gathering physically for a week-long period. There is a need to connect and familiarize people beyond emails and video conferences in order to lower the threshold for being in touch and seeking help. Face-to-face interaction is critical in creating trust. Getting together to engage intensively with others from all over the network is a strong way of promoting the desired ways of working and culture, especially for people who might be new to the network.

IDFW is also about *doing and concrete outcomes*. During the week, explicit attention is put on tackling problems and kicking off experiments on new development initiatives. Tangible projects are always agreed upon and first steps are agreed upon, scheduled, or preferably immediately taken already during the week if possible.

The week always has a carefully planned intensive program including workshops of different formats, keynotes and interaction with the local community. Careful attention is put to having a *balanced program* of intensive working, opportunities for catching one's breath by for example listening to keynote-type of presentations along with more informal interaction between the participants. Balancing different types of interactions and ways of working is critical for maintaining good spirit, energy and momentum through a week of long and intensive days.

Finally, and very importantly, the week should be *fun*. At the end of a successful IDFW, the participants are typically exhausted, but happy or as one might put it, *enjoyably tired.*

ORCHESTRATING FOR COLLECTIVE CREATIVITY

Learning from the professionally creative
to support moments of collaborative insight

Miko Laakso

Key points

- With complex challenges, lone creative geniuses are not enough, we need to embrace and enable collective creativity.
- Research on design thinking provides us with valuable insight into individual skills and abilities central in creative design and development work
- Social, or collective creativity builds on individuals. We should pay attention to both the individual prerequisites for creativity and creative social interaction, as well as to how the social environment enables and encourages moments of creative collaboration.
- Framing and reframing have been identified as key activities in creative design, which should be encouraged and reinforced by the organizational environment

As people who have picked up this book (or taken part in authoring it), we all probably wish to gear up our group, organization, community, or just ourselves to be a well-oiled creative machine. However, creativity is hard and might even be getting harder with the burden that the accumulating human knowledge presents on new discoveries.[1] Regardless of what consultants and creativity vendors might at times claim, creativity and innovation do not come in a neat little package. Over decades, we have been flooded with tools, methods and approaches for coming up with creative ideas. While the methods-approach is appealing and mastering creativity methods is likely to be helpful, it should not be our sole focus at the cost of other factors contributing to creative output. The tangibility of tools and methods makes it easy to forget the more intangible aspects of facilitating creativity.

Individual vs. collective creativity

In the West, creativity has traditionally been associated to an individual who generates a major breakthrough in science or art. Much of the early research into the nature of creativity and the creative process has focused on examining creative individuals. The myth of the creative genius still lives surprisingly strong with false or distorted accounts of the birth of inventions. For example, the greatest invention of Thomas Edison might not have been the lightbulb accredited to him (note also that Edison was hardly the first to develop an incandescent light), but rather his Menlo Park laboratory. In this facility – coined also as 'the invention factory' –a large team of engineers, machinists and physicists worked collaboratively on the inventions accredited solely to Edison in the mainstream storytelling.[2] Francis Jehl, a long-time assistant to Edison stated that "Edison is in reality a collective noun and means the work of many men".[3] Adding to this, famous designers have a history of frequently being willfully obscure about how they work and where their ideas come from[4]. Influential design scholar Nigel Cross accounts how star designer Philippe Starck is known to suggest that design ideas seem to come to him as if magically appearing from nowhere. Cross however illustrates how these visionary moments have much less mysterious explanations involving the context of the task and iconography where inspiration was drawn from. The focus on recruiting lone geniuses, or high performers in business has been obvious in recent history with rhetoric such as the "war for talent".[5]

The fact that innovation might intuitively seem to be lonely work might help to preserve the credibility of these myths and the idea of betting on the top talent. Indeed, the majority of our working time is typically spent on individual work where we apply our expertise to a problem alone, and breakthroughs definitely are also achieved in these moments. However, this individual work often builds on preceding collective efforts and the creative process is typically regarded to include some form of incubation[6], which means that the a-ha moments appear with a delay after the needed knowledge has been brought together. There are many indications that moments of collaboration might be the most important ones in creative endeavors. For example, Badke-Schaub and Frankenberger[7] observed that while designers and engineers spent 85% of their time working alone, 88% of the critical situations in a design process – situations where the design takes a new direction as opposed to routinely pursuing the current one – occur in moments of collaboration.

Innovation, creativity and making scientific discoveries is getting harder with the ever-accumulating body of human knowledge, as one needs to absorb increasing amounts of information in order to extend on it in order to generate new insights. Echoing on Isaac Newton's classical notion of creative ideas being built on previous knowledge, Benjamin F. Jones has stated that, "if one is to stand on the shoulders of giants, one must first climb up their backs, and the greater the body of knowledge, the harder this climb becomes".[1] The majority of contemporary theories of creativity define creativity as a combination of ***novelty*** and ***appropriateness***.[8] Novelty may be an obvious requirement, but it alone is not sufficient. However novel, if a creation is utterly useless and otherwise worthless, it is hardly creative. The second condition for creativity, appropriateness, could be also described as value (e.g. the experiential value of a piece of art) or usefulness (e.g. the usefulness of a new kitchen appliance). On the other hand, creative ideas do not spring out of nothingness. Rather, they are in essence novel combinations of existing knowledge[9], or old things in new combinations[10]. Creativity has long been recognized as a recombinant process where novel insights are created by importing and recombining schemas and scripts from other contextual domains.[11]

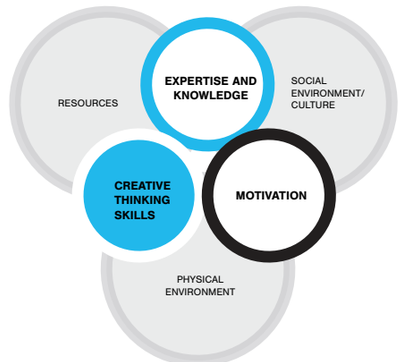
CREATIVITY = NOVELTY + APPROPRIATENESS

CREATIVE IDEA = A NOVEL COMBINATION OF EXISTING KNOWLEDGE

These foundational factors, novelty, appropriateness, and the construction of new ideas as combination of existing knowledge have implications on the prerequisites and dynamics of the emergence of creative ideas. They underline the need of collective efforts to reach creative outcomes. The people engaged in development need to be sufficiently informed to recognize what will be novel and appropriate in a certain context and to be able to benefit from and build upon the existing bodies of knowledge. While complex problems require the utilization on different skills, analytic perspectives and repositories of relevant knowledge, majority of creativity theories take the individual as the starting point; individuals are ultimately considered to produce the ideas even if it may be within a social setting. It could therefore be said, that individual creativity is a necessary but not a sufficient condition for innovation in a collective setting.[12] The first step in unleashing collective creativity is thus to make sure individual prerequisites of creativity and fruitful interaction are present.

Individual creativity is a necessary but not a sufficient condition for innovation in a collective setting

Decades of research from varied perspectives have informed us about what makes an individual creative. These different takes have examined issues ranging from how the environment we grow up in, our social background and education affect our creativity to examining the physical structure of the brains of famously creative persons, such as Albert Einstein.[13] While many of these takes on figuring out creativity are interesting, they are also beyond our influence and as such not particularly useful from the perspective of facilitating collective creativity. Of the various approaches, a very useful and classical take on dissecting creativity is the componential theory of creativity introduced by Harvard Business School professor Teresa Amabile.[14] Originally called the componential view, this widely accepted theory has been elaborated and updated since its first introduction to provide in essence a model of the psychological and social components that are foundational for producing creative results. The theory specifically proposes four components, stating that creativity ought to be highest when 1) an intrinsically motivated person with 2) high domain expertise and 3) high skill in creative thinking 4) works in an environment high in supports for creativity.[15] The componential theory however, considers only the social-organizational environment and not the effect of physical environment for creativity. While the influence of the physical environment might be weaker than that of the social environment it is still regarded as measurable[15], and thus should evidently be considered. Also relevant are the available resources, meaning access to relevant information, technologies, tools and the like.[16]



The components of creativity

Creative thinking skills are essential to unlocking creativity. Without this component in place, even a person with a high level of task-related expertise and intrinsic motivation and drive is severely hindered in her or his ability to produce creative results. Years of experience in the field can even be a detriment to creativity if not accompanied with creative skills as a large amount of domain knowledge might confine an expert to search within a limited space of potential solutions. In other words, domain knowledge may act as a mental set, promoting fixation in creative problem-solving attempts.[17]

Learning from the professionally creative – the rise of design thinking

Creativity is integral to, or even the very core of design work. Professional designers, regardless of their discipline, are required to produce creative outputs as part of their routine, everyday work. This makes it seem somewhat natural, that the world has turned its gaze to design in search for the solution to unleashing creativity. Recently, the creative capabilities possessed by designers have received a huge interest from fields and disciplines outside the traditional realm of design, which is evident from the booming discussion around the concept of design thinking. Since the introduction of the concept to the general public most notably by Tim Brown[18] in 2008 and shortly after by Roger Martin[19], interest has been steadily growing with numerous books and accounts of utilization of Design Thinking in different contexts.

Design thinking has been used to refer to the ways of working and methods utilized by professional designers for producing creative, outcomes. The term in itself is not particularly new as it was coined by Peter Rowe as the title of his 1987 book[20], in which he presented a systematic account of problem solving procedures in design. The recent connotation of design thinking, however, differs from the original, being used on one hand to refer to the process of creating innovations, and on the other hand to the qualities of people and organizations, including issues such as concrete, practical ways of working, thinking, and attitudes.[21] Transferring these creative approaches professionalized within the design discipline to other contexts and uses has been proposed to create novel possibilities for creating significant value and even ground-breaking innovations. The variety of proposed application areas for design thinking ranges from business education19 to military planning and command.[22] A huge number of proponents (both individuals and organizations) have surfaced with examples of successful outcomes supposedly deriving from the implementation design thinking being brought up around the world.

However, the recent manifestation of the concept has not been greeted in unanimous celebration. Some of the noteworthy and influential critics include Donald Norman[23] and Bruce Nussbaum.[24] Norman originally perceived design thinking falsely presenting a myth of designers "possessing some mystical, creative thought process that places them above all others in their skills at creative, ground breaking thought", essentially regarding it merely as "a public relations term for good, old-fashioned creative thinking". Nussbaum, originally a keen advocate of the concept, on the other hand, coined design thinking as a failed experiment. While he considered huge success being made in formalizing the tacit values and behaviors of design, his claim was that the proponents of design thinking had wandered off to an erroneous direction in order to appeal to the business culture of processes by "packaging creativity within a process format", which dilutes the concept of its non-process aspects. Here our interest lies in these non-process aspects of design thinking.

While Norman later softened his initial position, it would indeed seem that the idea of design as an activity significantly differing from non-design activities is accepted prima facie in majority of the popular design thinking rhetoric where the design thinking approach has been presented as being in stark contrast to other approaches, often labelled as "business thinking".[19] However, in the academic research on design, the question of if or how design differs from other human activity and thinking has received some attention. In regards of discussing design thinking and the creative abilities specific to design, it is not trivial to indicate what makes design specific. Furthermore, design is not a uniform discipline but rather denotes to a wide variety of design fields or domains. However, while some skills are quite specific to certain design domains, design involves other skills or abilities that are so generic and fundamental that they can be applied to all forms of design practice. Although the products designed are different, the processes of their creation are similar in many ways.[25]

Drawing from the early writings on design thinking, a dissection of the concept is presented below. The table presents a perspective of what has been regarded as the specific approaches, behaviors, and cognitive aspects of design thinking. This depiction essentially describes what is seen as specific to design as creative problem-solving that can be applied to a multitude of different contexts. When stripping design thinking from the process-oriented depictions, we can identify abilities that can be targeted in developing individual creativity.

PRACTICES	COGNITION	MINDSET
HUMAN-CENTERED APPROACH People-based, user-centered, empathizing, ethnography, observation	*ABDUCTIVE REASONING* The logic of "what could be", finding new opportunities, urge to create something new, challenge the norm	*EXPERIMENTAL & EXPLORATIVE* The license to explore possibilities, risking failure, failing fast
THINKING BY DOING Early and fast prototyping, fast learning, rapid iterative development cycles	*REFLECTIVE REFRAMING* Rephrasing the problem, going beyond what is obvious to see what lies behind the problem, challenge the given problem	*AMBIGUITY TOLERANT* Allowing for ambiguity, tolerance for ambiguity, comfortable with ambiguity, liquid and open process
VISUALIZING Visual approach, visualizing intangibles, visual thinking	*HOLISTIC VIEW* Systems thinking, 360 degree view on the issue	*OPTIMISTIC* Viewing constraints as positive, optimistic attitude, enjoying problem-solving
COMBINATION OF DIVERGENT AND CONVERGENT APPROACHES Ideation, pattern finding, creating multiple alternatives	*INTEGRATIVE THINKING* Harmonious balance, creative resolution of tension, finding balance between validity and reliability	*FUTURE-ORIENTED* Orientation towards the future, vision vs. status quo, intuition as a driving force
COLLABORATIVE WORK STYLE Multidisciplinary collaboration, involving many stakeholders, interdisciplinary teams		

A non-process view on design thinking[21]

One of the most fundamental and universally quoted aspects of design is the ill-structured nature of the problems designers as professional practitioners deal with. "wicked problems"[26] and messy situations can be said to constitute the normal and everyday context of any design practice.[27] This nature of problems results in solutions being likely to emerge only gradually through an iterative process where a significant role is played by how the problem is articulated and interpreted[28] as the perceptions of the problem influence which solutions are considered as relevant.[29] Overall, the co-evolvement of problems and solutions is a defining and fundamental aspect of design.[30]

Building on the 50-odd years of design research and extensive studies of professional designers, leading design scholar Kees Dorst has labeled ***framing*** as the core activity of design thinking.[31] He describes frame creation – or framing and reframing – focusing

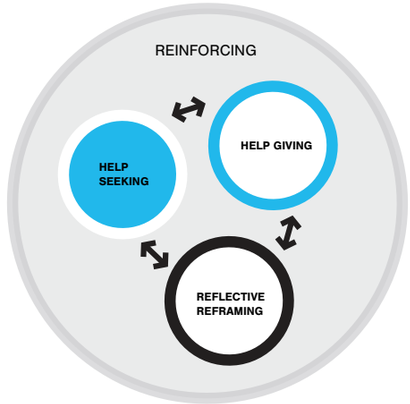
not on the generation of solutions but on the ability to create new approaches to the problem situation itself. In design, framing is often seen as the key creative step that allows an original solution to be produced.[32] The notion of framing largely derives from Donald Schön's influential work on reflective practice.[33] At the heart of Schön's reflection in action is the frame experiment, in which the designer frames – or in other words imposes a way of seeing – the problematic situation at hand.[4] In essence, Reframing refers to the adoption of a new frame for interpreting the situation, design context and task.[32] It could be said that framing and reframing is about making problems solvable.

An example of coming up with a new frame to making a seemingly impossible problem solvable is the case presented by Dorst[34] of designing out crime in Kings Cross, the entertainment district in the City of Sydney. Continuous problems with violence and other disturbances had been experienced on the concentrated area densely packed with nightlife and normal tactics aimed at prevention and punishing perpetrators such as increasing police presence, security personnel and installing cameras had not worked. Acknowledging that the mass of people composed of young people wanting to have fun instead of criminals and coming up with the metaphor – or a frame – of a large music festival opened up a variety of tried-and-tested solutions for organizing the area that could easily be put to place. Drawing from this frame inspired tactics that aim at removing the grim atmosphere (partially generated by excessive police and security presence) and providing facilities (such as chill-out lounge-style areas) that were not available to reduce frustration and directing the movement of masses of people with better signage and friendly guides.

Framing and collective creativity

Framing and reframing can be structured and intentional (Dorst present a stepwise process for organizations in his book Frame Innovation[34]) or spontaneous, often triggered by a novel perspective or good questions from another individual. Reframing can occur as a result of individual reflection throughout the design process[32] but is highly likely to manifest in moments of interaction. Studies on organizational creativity have recognized various conditions that support creative interactions in working environments in general, such as flexibility, possibilities to freely exchange ideas and explore mutual interests[35], and having an environment that is supportive and rewarding of creative ideas.[8] Particularly noteworthy from the perspective of framing and reframing, Hargadon and Bechky[3] have identified interactions that precipitate moments of collective creativity in organizations. Their findings draw from field study of six professional consulting firms (four product design and development consultancies and two management consultancies). Their evidence, collected through extensive field studies, suggest that while some creative solutions can be viewed as the products of individual insight, many are clearly the products of a momentary collective process with framing as the central activity. They illuminated how the locus of creative problem solving shifts between individuals and the collective with four sets of interrelating activities playing the key role in triggering moments of collective creativity: *help seeking, help giving, reflective reframing*, and *reinforcing.*

Hargadon and Bechky describe reflective reframing (or simply reframing) manifesting as "the mindful behaviors of all participants in an interaction, where each respectfully attends to and builds upon the comments and actions of others".[3] In other words; social interactions that trigger new discoveries of distant analogies or frames that the individuals alone could not have come up with. These moments can vary in their duration and degree of prearrangement, ranging from agreed-upon ideation sessions to a quick encounter in the hallway. The key activity leading up to these moments was found to be helping behavior – or collaborative help – in the organizations; people were willing and ready to both reach out for and provide help to others.



Dynamics of reflective reframing in collective creativity[3]

Collaborative help provides perspectives, experience, and expertise that improve the quality and execution of ideas – it's much more than mere workload sharing.[36] This help goes beyond pre-planned workload sharing, crossing the boundaries of for example the projects that people are officially assigned to. Such helping, that is, the "willing devotion of time and attention to assist with the work of others"[3] is necessary in organizations already due to the fact that when solving complex problems, people encounter dependencies and knowledge gaps that cannot be predicted or planned for. Carrying out development work is not just difficult, but impossible without such help from colleagues.[37]

This tendency to provide help leading to moments of framing and creative insight - "collaborative generosity"[36] - is definitely not a given. Helping another person is actually costly from the helper's perspective as it takes time and effort off the helper's own work, possibly leading to lower productivity.[38] Rather than reinforce helping, organizations may unintentionally retract it through structures and incentives that lead to a reluctance to provide or seek help. Achieving the supportive type of helping dynamics does not happen by itself, but rather needs conscious effort from the organization or community and the people involved. Reinforcing activities and factors are needed to support individuals as they engage in helping behaviors. Reinforcement has been found to result on the other hand from any positive outcomes and experiences of helping and reframing activities, and on the other hand, from the shared values and beliefs of the organization.[3] As an example, the exact birthplace of ideas is typically difficult to track down, but many reward systems are unfortunately geared towards awarding specific individuals or teams. These types of incentives support hoarding rather than sharing one's ideas and expertise, and are detrimental to encouraging collaborative generosity. Formal processes and roles need to be aligned to allow for these behaviors with for example leaving slack in employee schedules and explicitly acknowledging and rewarding seeking and giving help.

How people are networked to each other also contributes towards collaborative helping and arriving at moments of reframing. Network analysis of relationships in most organizations show people interconnected in small, tight groups, with only a few ties between groups, or patterns where almost everyone interacts mainly with a few central people. As tightly knit groups may become assimilated in their thinking and approaches, it is often thought that it is the weak ties that allow for diversity and that innovations are most likely found in the social gaps between groups.[39] However, looking into the networks in an organization prominent in collaborative helping, Amabile, Fisher and Pillemer[36] were struck by the sheer number of connections revealed by the helping network. They found most people to have a large and diverse array of helping interactions at their disposal. This large number of connections provides a much larger palette of helpers with differing perspectives than having to rely on one's tightly knit group or the odd weak connection to someone from another group. It is thus beneficial to aim for broad and dense networks of helpers – both within the organization and crossing organizational boundaries.

Cultivating a culture of helping and collective insights at Aalto Design Factory

Design Factory places explicit attention to fostering a culture of open sharing and discussion on challenges which essentially functions to enable help seeking, help giving and the resulting reframing activities. Some of the key principles include encouraging crossing organizational, hierarchical and disciplinary boundaries, lowering the threshold for experimentation by e.g. promoting hands-on doing and prototyping, inciting initiative and enthusiasm, and cultivating an open climate. In practice, this takes the form of maintaining low bureaucracy and hierarchy, strong communication on the desired culture, and practices that support interaction and planned coincidences. These are realized in the attitudes reflected explicitly and implicitly by staff and key community members, practices such as weekly informal low-cost breakfast open for anybody, along with visual messages and cues conveyed by the space itself, such as varying forms of providing information of the people and events within the community, single common kitchen/cafeteria for all, along with printed slogans and statements and labeled "Hugging points" where one risks receiving a friendly hug form anyone close by.

In studies of the ADF community, interviewees have frequently described the potential for ad hoc interaction that ADF provided.[40] Careful emphasis has been put into having spaces that support engaging in instant reflective reframing and other collaboration activities immediately on the spot. A significant share of the building is committed to spaces that can be instantly occupied without reservation and that have needed tools, such as ample amount of whiteboard, markers and other materials, at hand. Bookable meeting rooms are equipped with a touchpad booking system that instantly shows whether they are available and bookings can be made on the spot with a few taps.

The central role of the ADF staff and other core community members has been evident. The core members work as brokers who facilitate interaction and establish new connections between people. In a study including one week of observation in Aalto Design Factory Kafis, the cafeteria designed to spark and enhance interaction – often called the heart of the building – most of the initiated conversations involved ADF staff members, emphasizing the important role that the staff and regulars have in familiarizing the people with the community and creating linkages.[40] A centrally located face wall gallery with photos of regulars along with their names, affiliations and expertise makes it easier to find people who might know about the problem one is working on.

> ADF staff members explored the possibility of rigging the coffee machines to function more slowly in order to make people wait longer and more likely to start a conversation with someone.

Finally, in addition to purposefully seeking and finding help and partners for reflective consideration of one's problem, serendipitous encounters can provide an unanticipated moment of framing and reframing. Even merely having to explain the problem one is solving to someone else with a different perspective and repository of knowledge might lead to new avenues opening up.

Designing for serendipitous encounters at ADF has included considering such issues as whether people could be made to wait for their coffee longer. Finland has the highest consumption of coffee per capita in the world (with an annual consumption of 9,6 kg or almost a thousand cups per capita[41]), which makes coffee something you can use to affect people's behavior. Aalto Design Factory thus has only one centrally located spot where you can get your daily intake, no coffee makers are allowed elsewhere in the building. This supports people coming together and increasing the likelihood of serendipitous encounters whilst waiting for your coffee. In contrast to the typical efficiency-oriented thinking of making it as fast and efficient as possible to get your coffee, a few ADF staff members explored the possibility to rig the coffee machines to function more slowly thus making people spend more time waiting for their coffee and more likely to start a conversation. While this unfortunately was not possible (at least not without voiding the warranty on the machines), the consideration of such an option is an descriptive example of simple and unconventional ways of facilitating interaction and chance encounters.

Conclusion: three takeaways for unlocking collective creativity

Collective creativity builds on individuals

While we should not count on lone creative geniuses, individual creative abilities still pave the foundation for collective creativity. We should not forget to promote and support the development of individual prerequisites for creativity as well as to avoid encouraging protective ownership of ideas.

Framing and reframing are key actions

Dissection of design thinking reveals us a variety of skills and abilities that can be developed for more creative outcomes. Of these, framing and reframing present a central skill that help uncover novel perspectives and avenues to explore when solving a problem. More often than not, the generation of new frames is triggered by outside perspectives and knowledge in social situations.

Support interactions that lead to moments of collective insight

Support interactions such as seeking for and thoughtfully giving help in order to facilitate moments of collective creative insight through framing and reframing. Focus on facilitating the formation of broad and dense networks of help. Design for low threshold for engagement in collaboration on the spot and accommodate for serendipitous encounters.

WORKING IN UNCERTAINTY

Managing experimentation-driven projects

Lotta Hassi
Satu Rekonen

Key points

- Experimentation is a key innovation activity, and it is fundamentally different from planning-driven work. Project management needs to understand these differences and adapt the managerial support to fit the requirements of experimentation-driven projects.

- In order to successfully navigate experimentation-driven projects, managers must understand the requirements and roles of the different actors involved in the process: the individuals, the team as a whole, and their role as managers.

- From the perspective of an individual, experimentation requires a certain set of psychological characteristics, relevant technical know-how in experimentation, and certain cognitive abilities.

- A team's ability to act as an information processor, and to learn and create information from the experiments is highlighted in experimentation-driven projects.

- A project manager needs to prepare the team for the iterative nature of experimenting and hold back the team's urge to "close the idea."

An experimentation -driven approach to innovation

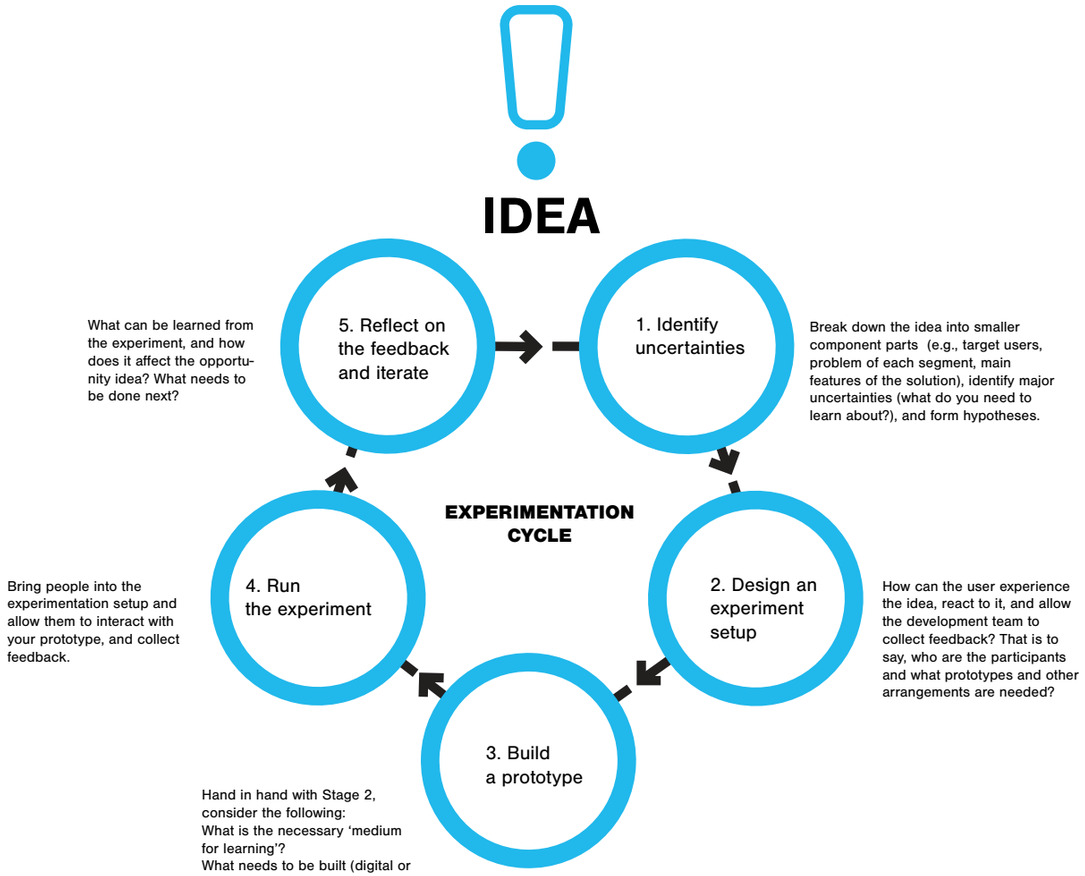
Creating new innovative solutions—be they new products, services, or business models—is not a clean, straightforward process. It is messy, uncertain, and ambiguous. It is a process where we do not know the outcome of the process at the outset and we do not know how to get to that outcome. There is uncertainty regarding all the necessary things that we need to know in order to create a good plan and execute it successfully. That is why innovations cannot be realized through rigorous planning. You cannot plan what you do not know. Instead, innovations are created through a process of experimentation, where innovative solutions emerge from iterative prototyping, simulating, and modeling activities that explore different alternatives[1].

Although experimentation is a fundamental innovation activity and nothing new as such to the management world, most innovation activities in organizations are characterized not by experimentation, but by planning—choosing a desired outcome and a course of action at the outset of the project, and then designing and executing a project plan based on them. Planning-driven approaches, such as the well-known Stage-Gate model[2], are intended for situations where there is enough information to make a plan at the beginning of the project. A development team knows, for example, "what" to create and "how," and can hence deduce the result that should be created[3]. In other words, the level of uncertainty is relatively low.

But when creating something truly novel, a project team does not have enough information to make a plan that would lead to the successful execution of a project. The customer requirements, how they should be addressed, and with which technologies—the "what" and the "how"[3]—are unknown. Even the customer group itself might be unknown. There are more questions than answers, and that is why the planning-driven approach does not offer adequate support[4]. The information the team is lacking has to be created through explorative experiments, where the project proceeds one step at a time, reflecting on the new information that is generated and redirecting the course of the project based on this information.

Being skilled at experimentation, in addition to planning, matters if an organization aims to stay at the forefront of innovation by introducing innovative new offerings. Yet, there are numerous, deep-rooted, barriers to making experimentation an established approach to innovation in organizations. For example, there is a lack of management tools that would allow and support the reformulation of objectives along the project[5], incentive systems that are inconsistent with the objective of experimentation[6], and a lack of skills for designing effective and efficient experiments[7]. To make experimentation an established approach to innovation, these kinds of internal obstacles need to be overcome. Further, there is very little previous research on what experimentation requires from the people involved in running the experiments: the individuals that form a team, the team with its internal dynamics, and the closest management who are leading both the individuals and the team.

The starting point for experimentation-driven innovation is the combination of the objective to create something novel with the lack of the necessary information to do so. Therefore, the goal of experiments is to help you learn what to create and how. An experimentation cycle (pictured below) begins by identifying uncertainties in the idea: Which aspects of the desired solution are assumptions and not validated knowledge? You then proceed to designing an experiment that allows you to learn whether your assumptions are correct. As new information is obtained from the experiments, the project goal and the course of action are flexibly adjusted based on this new information.



Stages in the Experimentation Cycle

Let us say that you are developing, for example, a new service and you notice that the channel you are thinking to use to reach the target market is based on an assumption. You need to validate this choice before moving forward and spending more time, money, or effort in developing the solution further. You design an experiment setup where information about your solution is placed in one location of the intended channel, and you stand by, observing if and how it reaches the target audience. The learning provided by an experiment is those aspects of the outcome that the person conducting the experiment did not (was not able to) know, or foresee or predict, in advance. The learning is used to revise and refine the target of the development activities, and progress is made in this way, iteratively, towards an acceptable result.

The key success factor in the experimentation-driven approach is to keep the cycle small and fast; the learning should come early and often since changes early in the project are less costly than those that come later in the project. Effective learning cycles are focused, fast, and they create learning. If there is no focus, you risk developing the non-critical parts when you should be working on the make-or-break parts of the solution. If there is no speed you risk running out of resources, or investing more than you can afford to lose if the experiment reveals your solution does not have the future that you had planned. If you do not collect learning, you are just keeping yourself busy but not doing anything of value[8]. *Therefore the objective of experiments is always to create the maximum amount of relevant learning with the minimum investment of resources.*

What, then, is a failed experiment? People often say that an experiment failed, when they actually mean that the idea they had, and experimented on, did not work as they intended, or did not generate positive feedback. This is not a failed experiment but a failed idea, and therefore in the context of learning it can even be considered a success (now that you know what does not work, you will not keep spending further resources in the development of an idea, or part of an idea, that does not have a future). A failed experiment is one that does not produce new or relevant information. Naturally, the failure of ideas is not the goal, the success of ideas is, but failures cannot be completely avoided when creating something novel. Therefore, they need to be considered as a natural part of the process and accepted as such. There has to be a genuine possibility for "failure," that is, finding out that something does not work as intended and changing the outcome and the route to that outcome based on what has been learned through that "failure." Such an option is hard to maintain if too much is invested in the idea—or if the people in the project have fallen in love with the idea.

Life in experimentation-driven projects: What does it require from the people involved?

When an organization aims to adopt an experimentation-driven approach as a way of working, management plays an important role. The most promising scenario for fostering innovative attempts throughout an organization would be when managers at all levels are aligned in their support for such behavior[9]. Top management most strongly shapes an

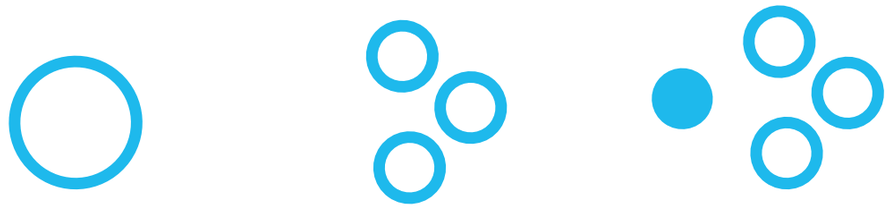
organization's structures, processes, and culture, but it is the immediate managers (e.g., project managers) who usually put those alignments into action. Role modeling has been emphasized as being important in showing what is valued and accepted in the organization[10,11]. Through their behavior, managers can show what is valued and appreciated behavior in an organization[12]. Hence, the way project managers behave and communicate can either encourage or discourage experimentation.

In order to successfully navigate experimentation-driven projects, managers are well-served to understand all of the levels of actors involved in the process: the individuals, the team as a whole, and their role as managers (see the illustration on the right). On the individual level, it is often relatively easy to convey to people that experimenting (instead of mere planning) is a good way to proceed. However, transforming that intellectual realization into behavior is challenging. We have often witnessed a tenacious hesitation, like an invisible force, keeping the people in project teams from moving from conceptual thinking to the practical action that experimentation requires: leaving the safety of the office, getting in contact with the potential customer, and receiving feedback on the idea being developed.

This behavior of people in experimentation-driven projects stems from three areas. First, experimentation taps into a different set of emotional resources than a planning-driven project does. It requires a certain set of psychological characteristics from the people running experiments. Second, what keeps many people from getting out of the building and running an experiment is the lack of relevant know-how. They do not have the knowledge of how to design and execute experiments. Third, experimentation requires certain cognitive abilities, namely the skills to process information. Each of these requirements are discussed in more detail below.

On the other hand, no matter how capable the individuals might be at experimenting, at the end the team needs to be able to move forward as a team. Working in an experimentation-driven project, where the team needs to create information and learn through iterative experiments, team members need to take action despite the discomfort of working together in an uncertain environment with a high risk of failure[13]. When the goal is to develop innovative and novel solutions, learning by experimenting is a crucial part of the process. This necessitates both help seeking and the freedom to express one's point of view without the fear of negative judgement[14]. Hence, in addition to being able to take action despite the prevailing uncertainty and ambiguity, team members working in an experimentation-driven project have to face interpersonal risks, such as appearing incompetent or disagreeable[15]. Psychological safety has long been recognized to be important when it comes to innovative work[10,16]. Baer and Frese[16] for example emphasize that people are more courageous in proposing new ideas and taking initiative—key behaviors in experimentation—in environments that provide a personally non-threatening and supportive climate. In our empirical work, it also became clear that the way in which team members react towards others' ideas and suggestions matters a great deal and affects the likelihood of an idea ever evolving into an experiment. Teams that build more on each other's ideas, provide positive comments and show enthusiasm towards others' ideas have more fruitful discussions. On the other hand, we have also seen how non-supportive reactions work: On most occasions, they kill the discussion before it ever really starts.

Leading the individuals and the team as a whole in creative efforts, such as experimenting, requires manager behaviors related to both leading the work and leading the people. Our observations have also proven that supporting experimentation requires both people-related actions (supervisory support in the form of providing a mandate to experiment, continuous encouragement, and preparing an appropriate mindset) and task-related actions (the coordination of experiments through creating supporting structures, the leeway to experiment, and facilitating experimenting) from the project manager. We next explore each of these individual, team, and managerial requirements in more detail.



INDIVIDUAL

- ***Cognitive abilities***: iteration between conceptual and abstract thinking, divergence in thinking
- ***Psychological characteristics:*** attitude towards failure, uncertainty tolerance, openness to learn
- ***Experimentation know-how:*** identifying uncertainties, designing valuable experiments, collecting learning

TEAM

- ***The experienced level of equality in the team***
- ***Collaborative sensemaking***
- ***The experimentation mode***
- ***The team's attitude towards further development***

PROJECT MANAGEMENT

- ***Supervisory support:*** the mandate to experiment, continuous encouragement to experiment, preparing an appropriate mindset
- ***Coordination of experiments:*** creating a supporting structure, the leeway to experiment, facilitating the process

Factors affecting experimentation behavior at different levels

Individual-level factors

Mental flexibility and divergence

As experimentation is essentially a learning process, the ways one processes information—that is to say, one's cognitive abilities—make a difference. Successful experimentation involves moving flexibly between conceptual and practical thinking. One needs to maintain the connection between conceptual thinking at a higher abstraction level (e.g., the overall objective and vision related to the idea) and the practical thinking of a lower abstraction level (e.g., the testable elements of a potential solution and practicalities of an experiment setup), and move swiftly between these two levels. This constant iteration between conceptual and practical thinking can be demanding, especially if one is significantly more adept and comfortable in one type of thinking over the other.

One also needs to stay open to exploring different possible directions for the development of the idea—the different formats it could take—before closing in on a final format. An urge to converge early on one option or format hinders the ability to experiment on different options because it closes one's mind to other possible solutions that might be better suited to the needs of the project. Often, people fall in love with the first idea that comes to their mind, they do not leave room for other possibilities to arise or to be considered and rush to study the implementation of that first idea. Divergence in thinking ensures that possibilities are not ruled out hastily, without consideration, and that ideas are given time to evolve to their best potential.

Accepting failure and surprises as a natural part of the process

Failure and unexpected events are a natural part of the process that cannot be avoided. Yet most people have a natural avoidance of failure, not to mention avoiding acknowledging and sharing their failures. Overcoming these social barriers (the psychological reactions towards failure) is one of the most important prerequisites for experimentation[11]. An individual's attitude towards failure affects his or her willingness to experiment with alternatives in the first place. It also affects how willing he or she is to share and explore received critique—which is key in order to contribute to the learning of the project.

Exploring unknown territory is like trying to find your way in darkness: It requires uncertainty tolerance. This is about the ability to keep moving comfortably without a detailed plan, allowing the plan to emerge through the experiments—those different encounters in the darkness. And while fumbling about, one must maintain the sensitivity to flexibly adapt the direction based on the learning from the experiments. The required information can only be created by continuous efforts to move forward through experiments. If one gets paralyzed by the uncertainty, the entire projects stops as well.

Furthermore, making the most out of the experiments—that is, collecting all potential new information—calls for a mindset that is open to learning. People who are open to learn are comfortable about having explorative, open-ended conversations that are aimed at learning more from others and the results of the experiments. The opposite would be people incapable of reflective conversations or postponing judgment and unreceptive to findings that do not support their viewpoints. This would hinder the overall learning in the project.

Aiming for effective learning

Successful experimentation naturally requires specific know-how on how to run effective and efficient experiments. Here, the ability to identify uncertainties is the starting point. It is the first step in deciding both whether or not to start an experiment and what the experiment should focus on. To identify uncertainties, one must break down the idea into smaller components, evaluate the uncertainties within those component parts, and identify the so-called make-or-break parts—that is to say, those uncertainties that could potentially "kill" the entire idea. People often struggle in realizing what the most important uncertainties at a given moment are. As a result, they then focus on experimenting with non-relevant parts of the solution, which wastes valuable time and does not move the project forward.

Once uncertainties are identified, the next difficulty is often related to designing valuable experiments, that is, experiments that create the needed learning with the minimum investment of resources (time, money, effort). It is easier to design a large, long, costly experiment than it is to figure out how to create the necessary learning with the smallest possible action or arrangement. The less resources spent on a project, the easier it is to make changes within it when results show that change is needed. Even when the experiment is well designed, people often have difficulties with collecting learning from the conducted experiments, that is to say, with identifying the information that is valuable for the project at hand. People tend to overlook unexpected information or do not realize the value it has. A common mistake is to purely look for "go" or "no-go" signs—either full acceptance or disapproval of the suggested idea—rather than look for pointers on how to tweak the idea in the following rounds of experiments.

Development team related factors

Being appreciative and supportive is the starting point

The experienced level of equality among the team members affects team behavior. Team members might put more weight on some team member's opinions than on others, such as those having longer working experience or those who are higher in the hierarchy of the organization. Even though all participants were equally inexperienced when it came to experimenting and there were purposefully no project managers in the projects we studied, we noticed that the existing hierarchy was still there in the background, affecting the dynamics in some of the teams. The more experienced team members seemed to be more confident in holding on to their ideas or bringing them up in the first phase. This led to a situation where the perspectives of all team members were not equally taken into account or heard in the first place. However, when it comes to innovative projects, where there is no one correct answer or direction to take, giving space to the idea that someone in the team is "more correct" than the others threatens the utilization of all of the creative potential the team has. Hence, we can conclude that a supportive climate—meaning one in which such things as the reactions of team members towards others' ideas and suggestions, as well as seeing everyone as equally capable—are not only important in

coming up with ideas but also when the team needs to take their ideas into practice.

Creating shared awareness and understanding

The team's ability to act as an information processor is highlighted because the development team needs to learn and create information through iterative experiments. Experiments are conducted in order to create relevant information and to learn whether to continue with the chosen idea or not and, if it is to be continued with the idea, what things need to be taken into account. *If the team is not learning from experiments, experiments are just quickly implemented ideas that make the team no wiser.* The team needs to be capable of creating shared awareness and understanding related to their project, and the information and learning that experiments have created. This collaborative sensemaking[17] is highlighted in experimentation-driven projects because the essence of experiments is to create the maximum amount of relevant learning. Collaborative sensemaking is the process of overcoming knowledge gaps that prevent the team from moving forward towards the desired goal. It can be characterized as a continuous effort to understand an ambiguous and uncertain context that may involve people, objects, places, and events[18]. On a concrete level, in order for the team to overcome the existing knowledge gaps, it needs to take the time after each experiment to reflect on the outcome, recognize the relevant issues that provide the needed information, and anticipate the needed future actions in order to move forward and to overcome the obstacles. This includes having the ability—as a group—to reflect and present explorative questions in order to keep the idea open, taking enough time for discussion, and also giving room for critical thinking about the team's actions.

The willingness and ability to conduct experiments

Being good at reflective discussion and keeping the idea open does not guarantee that the team is capable of conducting valuable experiments. *No matter how good the team is at noticing what needs to be experimented with next, there is sometimes "an invisible barrier," something that prevents the team from actually getting the experiments started.* The team needs to be able to move from the discussion and thinking to the concrete doing, acting on the recognized experimentation possibilities. Hence, the team needs to be in a so-called experimentation mode. An experimentation mode refers to the team's willingness and ability to conduct an experiment once the need for it has been recognized. It is important that the team has both the will and the ability. We have come to see that sometimes the team is only conducting experiments because they are encouraged to do so, rather than because they see it is valuable or because they are willing to learn. In fact, they might be thinking that conducting several experiments is nonsense, that they already know what they need to know in order to implement the idea and that conducting new experiments will not bring about significant information. We have observed situations where teams were conducting (invaluable) experiments just for the sake of doing something. The key is in acting for the sake of the critical learning required for the project and being able to recognize the elements or uncertainties worth exploring and experimenting with. Interestingly, our experience shows that although the team might be well capable of recognizing the key uncertainties, it is another story whether the team ever actually gets down to experimenting or not. They might get stuck on the thinking level and this mysterious invisible barrier prevents the team from realizing their valuable experimentation ideas.

Avoiding over-eagerness to close up

Experimentation is an iterative process. Let us say the team has conducted one experiment from which they received valuable information regarding their idea. The team might take the time to reflect on the outcome and create shared understanding related to the key uncertainties that the experiment tackled. But what might also happen is that the team is so satisfied with the successful experiment that they are not willing to go there again. Human nature seems to strive to wrap things up. It is much more tempting to stop experimenting and carry "the project" through rather than stay open to possible further development and additional experiments. Sometimes a lack of openness can result from the team suspecting that conducting another experiment would not offer any new valuable information—that it would be a waste of time and resources. If the team (or a dominant member of a team) is very confident of the idea being "ready," there is usually little motivation to open it up again and to test different parts of the idea. Hence, *the more confident the team is about the readiness of the idea, the less willing they are to keep the idea and their minds open to further development.* Experimentation is a lot about the team's attitude towards further development. The eagerness to close up an idea can be seen in the way the team discusses the idea and in the way they react towards the comments and suggestions coming from outside the team (for example from facilitators or supervisors). If the team is very confident about the readiness of the idea, the discussion becomes more about rationalizing why there is no need for further development and shooting down new suggestions rather than building on others ideas or seeing other possibilities. The team might even respond arrogantly towards suggestions for further experimenting that come from outside the team as they feel that this would only draw their attention and effort away from the essential activity (i.e. the realization of their idea).

Project management related factors

Providing explicit permission and showing interest

In a planning-driven organization, people are used to asking permission to develop their ideas further, which can take a long time and hence inhibit the agile development of ideas. Encouraging conducting experiments starts with a mandate to experiment, that is to say, explicit permission and authorization to conduct experiments that leaves no questions about whether it is a desired way of working or not. Our studies have shown that when employees feel they have a mandate to initiate the first steps to learn more about a possible solution and in doing so generate valid initial proof for their proposal, they will not only bring more valid arguments to the table when discussing the next steps but also maintain their team's energy and excitement towards the project better. Hence, having permission to actually act on your ideas has an important effect on team well-being. However, providing a mandate to experiment is not enough. Especially when it comes to organizations that are not familiar with experimentation as a way of working: Showing continuous attention and interest towards experiments is highlighted. This means simply asking the people about the experiments, about what have they learned from them, and reminding people to continue conducting new experiments when required.

Ensuring people are aware of the nature of experimenting

Development teams need to be prepared for the iterative nature of experimentation-driven projects, that is to say, for conducting several experiments and going through the experimentation cycle over and over again. What we have come to notice is that if this is not communicated properly, the people involved might feel that conducting further experiments means they have failed because they were not able to nail down all the uncertainties related to their idea with the one experiment they conducted. Further, if the people are not mentally prepared for conducting several experiments, they will most probably lack the motivation to do them and be eager to "close the idea" sooner. The urge to implement one's idea directly seems to be very strong. In addition to recurring experimentation cycles, the development team needs to be prepared to face the fact that experiments may not support their initial idea, meaning that they might need to update it or even come up with a new one. This is often seen as a failed experiment, although it has given important information early on about whether or not to take the initial idea further. Hence, the project manager needs to ensure that the people involved in the project are prepared with an appropriate mindset, meaning that they are well aware of the features of experimenting from the very beginning.

Enabling focusing on the essential

The essence in experimenting is to capture the learning it provides. This alone requires a lot of thinking and reflective discussion (time and effort from the team). The less the team needs to put effort into thinking about operational practicalities—such as when the team is supposed to meet, when will the experiments will be conducted, and what is the desired activity and outcome in each stage—the better they can focus on the essential. This is why it is important to ensure that the team, together with the project manager, will take the time at the beginning of the project to create their ways of working and to ensure that there is a common understanding on the deliverables at different stages. The better these supporting structures for experimenting are created during the first steps of the project, the less attention they require later on.

Knowing how far the team can go on their own

Closely related to the supportive structure is the leeway to experiment. This refers to the team being fully aware about the resources in use and the level of autonomy they have. For example, the development team needs to know whether they have a budget to build a prototype for the experiment and in which kind of situations they need to ask for formal permission (e.g., if the experiment is conducted in a collective space of the company) in order to move forward with their experiments. When a culture for experimenting does not exist in the organization, the issues mentioned above may become hindrance to taking action.

Ensuring learning

Keeping the idea open and objectively analyzing the results of the experiment seems to be challenging. Facilitators that are not part of the team play a big part in ensuring the team is keeping the idea open and reflecting objectively on the results of the experiment. We have witnessed that an external facilitator helps the team to reopen their idea to different possible solutions and gets them convinced about the importance of conducting more experiments. With a kind forcing from the facilitator, the attitude and approach of the team towards the project can change notably. Hence, facilitating experimentation may be needed in order to make sure the team takes the time to reflect on the experiments in order to collect the learning and to be able to update the idea.

Guidelines for Managers

Establishing appropriate conditions for experimentation in an organization requires addressing different factors on the levels of individual, team, and project management. Establishing a process for experimentation, training the personnel with the necessary experimentation know-how, and providing access to necessary resources are key, but managers also need to consider factors related to team dynamics and the cognitive abilities and psychological characteristics of the individuals, as well as consider how to best orchestrate the experiments and provide the room and support that the exploration requires.

First of all, managers should signal that constant and early experimentation is desired, and that failures are unavoidable and necessary for learning by encouraging the identification and analysis of failures. Psychological safety has been noted to play a significant role in supporting experimentation because it reduces the fear of failure; it helps to overcome the psychological reactions that most people have towards failures[11] and in that way promotes experimentation. Earlier studies have shown that in organizations where failures are expected and accepted as a part of learning, people tend to talk more easily about their mistakes[10]. This is central when it comes to experimenting, since talking about mistakes, or failures, ensures that they also produce learning. In fact, failures should not be seen as mistakes since they produce new information— learning—which is the goal of experimenting[1]. Accepting unsuccessful trials as a necessity for innovation and as unavoidable outcomes of experimenting is a precondition for achieving an experimentation-driven approach.

As experimentation is an iterative process, the team and the individuals need to be emotionally prepared for the uncertainty and iterative nature of the experimentation approach. Reflection is a fundamental part of creating learning in experiments. Whereas designing and running an experiment creates information, reflection is needed to collect that information and to make it useful for the project by building on the learning. Without reflection, learning (the key success factor of experimentation) does not happen. However, to an unprepared mind, the continuous reflection and redirection of the project are very likely to cause frustration as well as a loss of motivation and interest, resulting in the stagnation of the project. Managers need to explain the nature of the work to the team up front and ensure that time is taken to reflect on the progress (i.e., the accumulation of learning) throughout the process. This allows the individuals to comprehend and appreciate learning as a measure of progress in experimentation. As reflection has such a significant impact on the project, managers need to provide a supporting structure, time, and guidance in order to ensure systematic reflection.

Further, from an individual's point of view, experimentation requires courage, tolerance of uncertainty, and the ability to face failure. All of these characteristics are emotionally demanding and more present in experimentation-driven situations than planning-driven situations. Therefore, understanding the emotional experience of experimentation and providing the appropriate support to meet these demands are particularly important in the experimentation approach. Managers need to remain sensitive to the emotions that surface throughout the different stages of the experimentation cycle and meet them with both adequate support and acknowledgement that they are a natural part of the process.

When running experiments, teams often experience difficulties in identifying events and signs that are potential learning points. Especially events that do not support the initial assumptions of the project team (i.e., events with cognitive dissonance) are easily overlooked and events supporting the thinking of the team are given more emphasis (i.e., there is confirmation bias). Also, teams tend to disregard significant comments or behaviors that seem insignificant simply because they have not been studied before and the team is not yet aware of their potential impact. These instances further underline the need for time, structure, and specific support to be given to both the reflection upon and interpretation of the experiments. In order to be able to provide the needed support (both technical and emotional) for the team, experimentation requires a project manager who has a deep understanding of the nature and requirements of experimentation.

Rules of Thumb for Managers

1. Give a clear mandate to experiment in explorative projects: communicate clearly the desired behavior and lead by example.

2. Ensure the team knows their leeway to move on with experiments without asking for formal permission (inform about, e.g., the money available for building prototypes and the time they can use for conducting experiments).

3. Communicate that unsuccessful experiments are unavoidable and a necessary part of learning. Intelligent failures are acceptable, even desirable. Share information about failures as well as successes. Encourage identifying, analyzing, and learning from failures, for example, by "blameless reporting."

4. For teams that do not yet have much experience in experimentation, help them understand the iterative nature of the approach before starting the project in order to avoid frustration and loss of interest. Consider, for example, sharing a visualization of the process of a previous project, the path that team went through as they learned through experiments.

5. Guide the team over the "invisible barrier" from abstractive thinking to concrete action by, for example, setting an expected mean time from idea to experiment.

6. Provide structures and processes for reflection and knowledge sharing. For example, take the time for this key activity by facilitating weekly meetings—reflective project reviews. Ask team members to also share their emotional experience (e.g., nervousness when facing the customer, the excitement created by an important new learning).

7. Create the time and setting for open and explorative conversations amongst the project team in order to ensure the team does not converge prematurely, for example by promoting explorative What if ...? questions.

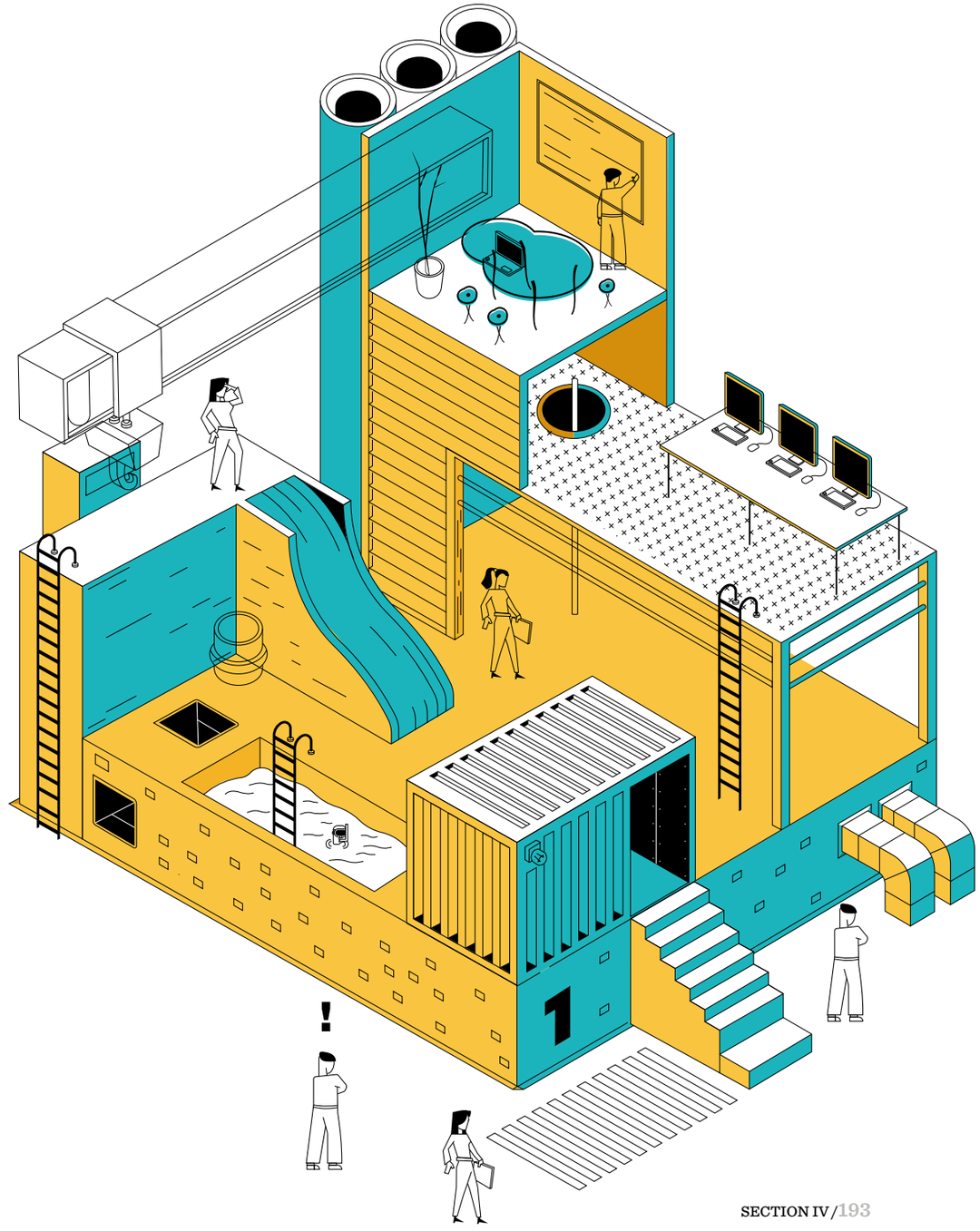
8. Show a continuous interest towards experiments by being present and asking questions, as well as by being understanding about any moments of frustration or doubt.

LEARNING LABORATORIES AS TOOLS FOR CHANGING THE ORGANIZATIONAL LEARNING CULTURE

Maria Clavert

Key points

- Top-down development efforts may be hard to connect to operational-level strategies
- Bottom-up change agents are better aware of operational development strategies but may struggle with connecting back to the formal structures of the organization
- Learning laboratories provide opportunities to experiment with new behavior in a safe, simulated environment to accelerate learning
- Communities of practice formed around design factories can act as meso-level learning laboratories, mediating between the micro and macro levels of organizations
- Mentoring or other facilitation processes help to connect experiments at the learning laboratory to the "business as usual" operations of the experimenters



SECTION IV
LEARNING
LABORATORIES

Learning laboratories as tools for changing the organizational learning culture

Organizational learning refers to the process of developing shared understanding in order to improve collective performance. It was already identified as a key to organizational flexibility and competitive advantage in the 1990s: the more profound the aimed improvement, the more important the role that learning plays in changing organizational behavior. Even though the development pressure concerns all levels of organizational actors, the task of promoting organizational learning has typically been limited to the macro-level actors, such as managers, human resources experts, or professional developers.[1] The top-down development approach has been widely criticized for being disconnected from the local contexts and ways of working on an operational level.[2-4] If the top-down development initiatives do not seem meaningful for all members of the organization and do not match the local practices, the nature of the change is more likely to be cosmetic than profound.[5,6] In addition, organizational structure has a tendency to guide social behavior and even out the individual differences resulting from, for example, in-service training.[7] The challenge lies in connecting the organizational-level vision with the daily activities of the operational level.

In recent years, research has increasingly focused on the potential of the organizational micro level in promoting collective development. This bottom-up approach to organizational learning is based on local actors and strategies that ultimately define how the organization functions in practice. For example, informal *change agents*[8] can engage in local development strategies with implications for the organization as a whole. Any organization member, without any formal developer or managerial status, can act as a change agent by promoting learning related to the shared meanings, practices, identities, and ways of belonging to communities. Change agent activities can be triggered by an identified need for change, new resources becoming available, or a request from a superior or another stakeholder to make changes in the shared practices. In one of our recent studies, even having just one supportive colleague and witnessing positive effects resulting from the new activities sustained the development efforts.[8]

The bottom-up development approach assumes that individual organization members, without any official authorization, are able to advance their development ideas, involve colleagues in the shared learning process, and establish new practices within the organization. However, previous studies have identified challenges related to involving colleagues in the development process and connecting the informal development activities with the formal structures and processes of the organization. For example, our study revealed that informal change agent activities could be diminished or overridden by contradictory managerial-level development decisions. Also the change agents themselves can lose their development motivation as a result of increases in other organizational responsibilities, a lack of information on the official organizational structures and processes, or a lack of collegial support.[9]

Indeed, both top-down[3] and bottom-up strategies[9] for promoting organizational learning seem to suffer from the same challenge: integrating the development efforts with either the formal or informal operations of the organization. In addition, organizational learning would require such a level of trust and agility that is difficult to maintain in increasingly established large-scale organizations. Due to a strong guiding effect of the organizational culture and structure,[7] collective learning disabilities and ineffective practices are difficult to detect, and the behavior of the members typically confirms rather than questions the status quo. This chapter introduces the concept of a *"learning laboratory"* as a way of accelerating organizational learning between the official and informal layers of the organization.

Accelerating learning through learning laboratories

A learning laboratory is based on an idea of experimenting with new behavior and roles in a simulated environment.[1] The laboratory can be considered as a micro world, where the organization members can act outside of the organizational constraints, while still retaining their legitimate membership. The concept follows a full experiential learning cycle[10] starting from challenges and development needs drawn from daily organizational practices. These challenges are then tackled by providing the organization members with a concrete experience of acting differently in relation to the problem at hand. After reflecting on the resulting outcomes of the new activity, the learners are encouraged to formulate generalizations drawn from the experience. The hypotheses are tested by applying them in practice either within or outside the laboratory environment. The time span of the learning cycle is short and the resulting feedback is both direct and immediate. In turn, experiencing successful results and gaining positive feedback on the development efforts build commitment to the new behavior.[9]

Senge and Sterman[1] have developed the learning laboratory concept to improve the performance of organizational managers and their teams. Learning laboratories can improve performance by supporting the development of more effective behavioral models. Typically the models behind behavior are implicit and remain unrecognized in daily work. You might act in an organization for years without ever reflecting on the operational assumptions you make. However, in the face of a disruption in the workflow, such as gaining negative feedback, the behavioral models become a target of critical reflection and can be replaced by more effective models.[11] Learning laboratories have the potential to shorten this learning curve by making the assumptions and models explicit and creating a safe atmosphere for evaluating them critically. On the other hand, novices may especially experience difficulties in acting according to their models due to a lack of necessary skills or a suitable environment.[12] The laboratory concept provides an organizational "practice field" where the organizational actors can reflect, challenge, and revise their models by experimenting with new behavior.

Aalto Design Factory: A mediating meso-level for organizational change

In the universities in Finland, as in most universities globally, the application of the learning laboratory concept as a part of the typical organizational development practices has been rare. Aalto Design Factory (ADF), can be considered as one of the few examples of the learning laboratory concept successfully applied in a higher education context. It provides

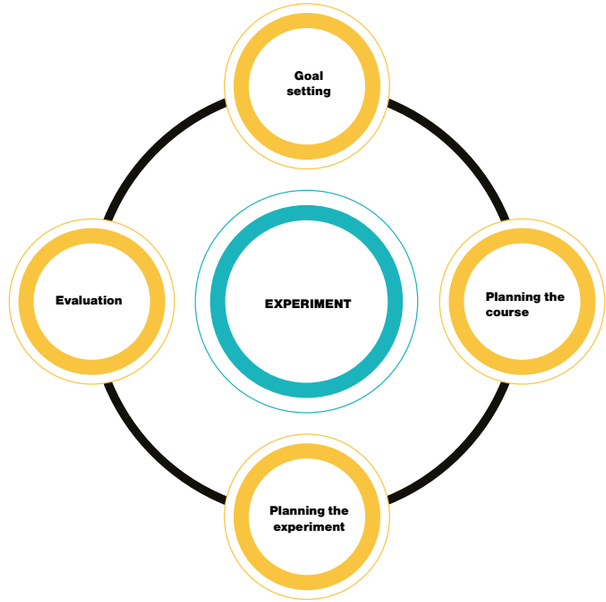
a platform for experimenting with student-centered learning approaches within the university. It functions as a low-hierarchy, constantly developing, collaborative platform for experimental teaching, undertaken to promote better learning outcomes. Within the organizational context, the ADF platform can be regarded as an independent community of practice[13] with its own core practices, budget, strategy, employees, and facilities. However, it is tightly connected to the wider university organization with clearly specified communication channels, interest groups, and managerial level contacts. Organization members can join the community by following either a top-down or bottom-up approach to organizational learning. The former approach typically entails participation in pedagogical training prior to experimenting with the new pedagogical ideas in practice at ADF. The latter approach is typical for the academics that wish to experiment with new teaching methods without participating in formal pedagogical training. Mediating between the macro and micro levels of the organization, ADF provides a novel, meso-level learning laboratory for promoting organizational development in higher education.

Learning at ADF is based on a situated approach[14] where the daily teaching practices are brought to the experimental development platform and shared with the other community members. Providing a physical platform and a socially supportive community that ignites intrinsic development motivation has the potential to support pedagogical development. The underlying assumption is that as the academics carry out the practices of the ADF community they educate themselves and each other. However, letting go of the traditional teacher-centered, lecture-based approach in a new teaching environment can prove to be more challenging than expected. It seems that even though the academics appreciate the supportive, informal atmosphere at ADF, they need more explicit, concrete support to effectively use of the platform outside their pedagogical comfort zone. This is particularly important for facilitating the translation of insights gained within the learning laboratory into new behavior in the organization at large.

Teaching Partner: Mentoring to support learning laboratory experiments

In order to support the effective use of the ADF platform as a learning laboratory, a practice-based pedagogical mentoring program, Teaching Partner (TP), was established in 2010. The program aims at increasing the effects of centralized pedagogical training courses, which can be considered as representations of a top-down approach to organizational learning. In addition to planning for good teaching, the participants are invited to implement new teaching methods in practice in an environment supportive of experimentation. Providing official study credits for the local bottom-up development activities legitimizes the informal learning that takes place outside of formal development courses. The mentoring program functions as the glue between the top-down and bottom-up approaches to organizational learning as well as communicates the value of the physical learning laboratory as a tool for organizational development.

In line with the situated learning approach[14] typical of the ADF platform, TP is based on operationalizing



The Teaching Partner mentoring proccess

theoretical pedagogical knowledge so that it can be used to carry out a specific teaching experiment. The learning of the theoretical content happens seamlessly as the academics move from relatively simple experiments on a session level to more profound developments throughout their courses. Previous studies have identified mentoring as one of the most promising opportunities for universities to support the development of novice university teachers.[15] At ADF, the mentoring approach is applied to harness the participants in order to benefit from the learning laboratory concept and connect the resulting learning experiences with the work at their own department.

Providing support for continuous learning and the ongoing creation of new ideas and skills is in line with the idea of social learning.[16] In TP, the understanding of pedagogical content is socially constructed through direct experiences and interactions with the students and the mentor around real problems and operational-level activities. During the course of learning, the participants experience the direct consequences of applying theory to practice. The social learning approach shifts the focus from the content (what is being taught) to the ways of working (how to ensure understanding).[17] The focus on the ways of working provides a basis for supporting organizational development across various disciplines.

The Teaching Partner mentoring process consists of three main elements: planning, executing, and evaluating a teaching experiment (pictured above). The process is agile and can be modified case-by-case

according to the individual needs and development motivation of the participants. Each step, as well as the full process, can be applied in various contexts and repeated several times.

Planning for new behavior

As the mentoring is centered on practical experimentation, the planning stage of the process is typically rather brief. The process begins with an introduction of the learning laboratory and the context of the participant—in this case, the ADF platform and the course intended for the ADF premises. The mentor asks questions on previous student feedback, learning outcomes, and the previous course development efforts. In most cases, the participant already has an initial idea that he or she would like to experiment with, and is looking for encouragement in taking the first steps. In TP, most academics are interested in enhancing interaction and student activeness in their courses. More detailed planning of the experiment usually consists of two to three meetings with the participant and, in some cases, also with colleagues teaching on the same course or study program. The discussion in TP typically covers some theoretical aspects related to, but not limited to, interdisciplinary course design, choosing appropriate teaching methods and evaluation practices for a project-based course, and ways of integrating working life skills into the subject-specific course content. The mentor documents the decisions made in each planning meeting in order to ensure common understanding and provide a basis for evaluating the outcomes of the experimentation.

Conducting an experiment at the learning laboratory

Based on the initial discussion, a small, manageable experiment is designed with the participant that will be tried out in the supportive learning laboratory environment. In TP, discussion about the course-level plan provides a basis for designing a teaching experiment that is aligned with the rest of the course. The experiment usually covers one to two teaching sessions and includes student-activating elements, such as interdisciplinary teamwork, the flipped classroom, opponent practices, student presentations in various settings, and role-play. The experiment might also include hands-on elements, such as a design project, visualization of knowledge, or building prototypes. In order to provide a coherent evaluation system supportive of the development efforts, traditional teacher evaluation is typically supplemented with peer and self-evaluation. The mentor attends the experiments and observes the implementation of the development plan from the perspective of both the teacher (the experimenter) and the students (the users or targets of the experiment). If necessary, the mentor provides practical support, ranging from organizing the learning space to collaborative teaching. At the end of the experiment, the mentor collects anonymous student feedback in a written format. In some cases, the mentor also hosts a facilitated feedback discussion between the students and the teachers of the course. Typically the development process begins with a couple of small session-level experiments at ADF and continues with course-wide developments conducted within the discipline-specific teaching environment.

For example, on a session level, teachers have experimented with the flipped classroom, fishbowl discussion, and various team-building exercises. On a course-level scale, the experiment could, for example, be to implement a design-based learning (DBL) project throughout the course. DBL is a pedagogical model that promotes the deep learning of technical fundamentals and practical skills in a context of real-world design experiences. The model situates the student at the center of a learning process, thus changing the role of the teacher from that of a lecturer to that of a facilitator. The typical stages of DBL include defining the problem and identifying the need, collecting information, introducing alternative solutions, choosing the optimal solution, designing and constructing a prototype, and evaluation.[18] The stages of the model combine elements of problem-based learning, project-based learning, and inquiry-based learning. These elements are, to some extent, applied in all teaching experiments conducted at the ADF platform. (For more information, see Clavert & Paloposki.[19])

Evaluation as a basis for continuous development

After the experiment has been conducted at the learning laboratory, the mentor meets with the participant to reflect on the session together and discuss the collected feedback. In TP, the feedback has been provided in an "I like I wish" format (see ilikeiwish.org) and transcribed by the mentor, helping to create a "safe emotional distance" between the feedback and the experimenter in order to promote reflection rather than defense. The focus of the feedback discussion is on the practical implications of the feedback. Especially on a Bachelor's level, the students can be rather conservative and favor the traditional lecture-based approach over the novel student-activating methods. Discussion with the mentor aims at putting the feedback into a wider context of pedagogical development in Aalto University. Analysis of the feedback provides a basis for making an improved plan for the next iteration round of the course. In most cases, TP mentoring continues outside ADF in order to ensure the transfer of learning between the learning laboratory and the discipline-specific teaching environment, such as the department. In some cases, the participants decide to keep some of their teaching sessions at the platform, thus resulting in a collection of ADF courses that can be presented as showcases for potential new experimenters.

Feedback collected from 60 academics that have taken part in the TP process so far has highlighted the importance of the practical and social support that mentoring can provide for acting in a learning laboratory. Support for evaluation of and reflection on their development efforts, and especially documentation practices, have been appreciated among the participants. When the participants were asked about their wishes regarding the mentoring process, they called for more justification and reasoning behind the choices made in the teaching experiments. They also call for more positive encouragement and pointing out their strengths as teachers during the development process. They also wish for more emphasis on connecting the individual experiments with the other activities of the course. These comments have guided further development of the mentoring program so it better supports the work of ADF as an organizational learning laboratory.

In brief, ADF provides a platform for connecting the organizational-level vision with the daily activities

of the operational level through experimentation. In addition to providing supportive facilities, tools, and methods that enable new organizational behavior, specific working processes are required for lowering the threshold for utilizing the platform in an effective way on an operational level. Specific processes are also required for communicating the value of the grassroots level development efforts, including both successful and failed experiments, as a part of the organizational development strategy. The mentoring process introduced in this chapter provides a concrete example of leveraging the learning laboratory concept as a tool (rather than merely a physical platform) for changing the organizational learning culture. The process can be applied to concretize the value of the laboratory concept for both the operational and managerial levels of the organization. The importance of supporting individual efforts to make a difference should not be underestimated in developing the collective performance of the organization.

TRANSFORMATION IS NOT A GAME WE CAN PLAY ALONE: DIVERSITY AS A KEY INGREDIENT IN THRIVING INNOVATION ECOSYSTEMS

Pauliina Mattila
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Key points

- Innovation ecosystems, which are important drivers for a larger societal wellbeing, consist of diverse interaction between diverse collaborators.
- Co-creation practices and co-creation culture facilitate the challenges of diversity and can maximize interactions and innovation in ecosystems and generate greater value across stakeholders, organizations, and individuals in the ecosystems.

"If you want to go fast, go alone. If you want to go far, go together."

African proverb

Thriving innovation ecosystems drive economic growth, deliver new jobs, and create prosperous communities for residents to live, work, and invest in and for them to visit. Thriving innovation ecosystems are multilayered and, through a co-creative mindset, they are a key driver of societal wellbeing.

Ecosystems, often referred to as regional innovation processes, have drawn particularly large interest in the context of interorganizational development, collaboration, competitive advantage, and economic growth, even on a national level. In academic research, innovation clusters are often described as industry specific, while innovation ecosystems can consist of multiple economic relations and clusters as well as sociological interactions and culture[1,2]. Multilayered ecosystems differ from more traditional transactional collaboration. Multilayered ecosystems combine interconnected stakeholders—including the public sector, industry, and universities and other research organizations—into structures and models that help service providers, universities, both local and national decision makers, and even nations to create shared and mutual value in society.

During recent decades these multilevel, collaborative innovation processes have been researched under labels such as open innovation[3], innovation clusters[2,4-7], innovation networks[8], and innovation ecosystems[1,9,10]. Despite the vast interest, existing academic literature provides rather fragmented insights into innovation ecosystems and their implementation in reality[11]. A number of factors that facilitate ecosystem success have nevertheless been identified. In particular, research calls for a better understanding of the role of people in ecosystems[11]. As ecosystems are comprised of different actors with different goals, expectations, and attitudes, facilitation and understanding of this collaboration are highly important. Extant literature has failed to leverage ideas from ecosystem co-creation[12] and is yet to take a holistic view of building innovation ecosystems. So far it has been seen through individual perspectives, for example the perspective of an industry[13] or a university[14].

We approach the development of productive multilayered innovation ecosystems with a co-creative mindset and through exploration of the value for all stakeholders. This chapter seeks to advance our understanding by identifying the key co-creative building blocks for innovation ecosystem success, focusing on enhancing the diversity of ecosystems on multiple levels, the practical implications for how to do it, and how co-creation facilitates the complex setup of diverse actors working together. We will explain how "a collaborative, co-creative approach involving all societal actors" is required for "realising a regional policy that focuses on creating new opportunities for enhancing growth, competition, and quality of life in the region"[14].

The key to sustaining innovation is a constant cross-pollination of ideas, knowledge, and technology between actors. A more divergent mix of collaborators in the ecosystem is a predictor of more fruitful interaction and a greater tendency for innovation. Diversity is examined from three perspectives: diversity between collaborators, diversity in the nature of interaction, and co-creation practices. First we will explain what we mean by diversity in terms of the collaborators and then, secondly, in terms of the interactions. Finally, we outline how a shift to co-creation practices and co-creation culture facilitates addressing the challenges of diversity. There is no magic formula for how thriving ecosystems are built but co-creation is the essential ingredient to maximize interactions and innovation.

Diversity of collaborators in thriving innovation ecosystems

Various studies on innovation ecosystems as well as practice underline that innovation processes and knowledge sharing can benefit enormously from diversity[3,15-18]. Through a review into existing innovation ecosystems and diversity literature we have formed a framework that identifies different types of diversity in an ecosystem. The Multilevel Diversity Framework, as we call it, summarizes what kind of diversity is needed in thriving innovation ecosystems on multiple levels between collaborators and how the diversity affects the ecosystem. The following sections will cover in more detail how diversity on each level—sector, organizational, and individual levels—can underpin innovation and add value.

COLLABORATOR LEVEL	DIMENSION	IMPACT ON ECOSYSTEMS
Sector	Types of sectors	Risk management Sparking new ideas and novel solutions
Organizational	Horizontal–vertical partners Types of organizations Size	Extended capability and resources; the extension of markets The incentive for competition and differentiation Security in using new technologies The distribution of risk in R&D Sparking new ideas Unique knowledge
Individual	Qualifications Expertise/knowledge Nationality and cultures Newness to the industry Combined acquired and inherent diversity New–existing relationships	Sparking new ideas The cross-pollination of ideas Increased understanding of new markets and user needs

The Multilevel Diversity Framework.

Diversity at sector level

Diversity within the ecosystem at sector level can create multiple benefits. As described earlier, innovation ecosystems are often associated with a strong expertise in multiple sectors. It is however critical to identify the right balance between specialization and diversity within innovation ecosystems[19] in order to minimize the risk of becoming vulnerable to market and financial shocks. Highly specialized innovation ecosystems and single clusters are at more risk to new, competing innovations and economical turbulence. The 2000 dot-com meltdown provides a great example: It devastated not just the whole Silicon Valley (probably the most well-known example of innovation ecosystem) but also other leading ICT clusters across the globe. Despite the shock of the dot-com meltdown, Silicon Valley was able to recover from the crisis thanks to diversity in the industry sectors[20]. Although Silicon Valley is still well-known for its world-class technical organizations and innovations, it also attracts entrepreneurs, researchers, and engineers from around the world across industries including biotechnology and pharmaceuticals, medical devices, aerospace, and other specialized innovation services[21].

Furthermore, often the most innovative breakthroughs happen at the intersection of fields and industries[15,22] where innovators manage to combine new and existing methods and thinking from technology, problems, or ideas that previously seemed unrelated. The next sections in this chapter are about the nature of relationships and co-creation and they examine how the connections and interaction can be facilitated.

Diversity at an organizational level

Innovation at the organizational level has been recognized to play a central role in creating value and sustaining advantage from the perspective of companies. There are multiple ways in which diversity can be manifested on an organizational level.

First, an organization's innovation activities are significantly affected by the diversity of its direct contacts[23]. Innovativeness cannot be traced to an individual talent but rather to the company's capability to build a vast network. It could be argued that, looking at things from this perspective, a diverse network of partners might even form the core capacity of the firm. The greatest positive impact on the degree of innovation comes from collaborative networks comprising different types of partners including public, private sector, and research partners[24]. Second, interorganizational networks represent a complementary response to the insecurity arising from the development and use of new technologies. They also facilitate the accelerated flows of information while reducing the uncertainties of innovation[25].

Diversity also extends to the vertical and horizontal partners of organizations, such as the supply chain and direct peers within and between industries, including education and R&D organizations[6,26,27]. The horizontal dimension can play a significant role, especially in the early stages of cluster formation as competition and nudging one another creates an important incentive for innovation and differentiation[2]. Vertical links to, for example, suppliers or customers stimulate growth and create a demand for specialized services and supplies[28].

In addition, having a diverse mix of partners reduces the risks of R&D by distributing the activities, in the same way as at the sector level. Being too heavily invested in one organization might restrict future direction too much. This was the case in a partnership between the Finnish mobile phone company Nokia and Helsinki University of Technology (located in the city of Espoo in spite of its name). The company built research partnerships with the university for over a decade in order to carry on developmental research collaboration. Along with the anticipated benefits to both organizations they also exposed themselves to a risk by tying the reputation and research funding to one partner. Nokia was highly successful, however, it struggled to repeat the success in the ever-competitive smart phone markets, influencing the reputation and activities of the university. The university and the city of Espoo made efforts to mitigate the effects on research goals and threats to long-term funding by integrating other partners in the area[29].

Another benefit of liaising with a diverse mix of partners is that these relationships provide a unique type of knowledge that is not accessible to everyone. It has been found that additional investments for acquiring market knowledge from, for example, cross-pollination customers and competitors will directly increase organizational performance[30]. Especially considering a more future related direction and a longer time span, liaising with an organization beyond one's core business and industry provides an opportunity for future innovation[31]. Investments in opportunistic relationship and knowledge acquisitions should be seen as constant probing and training on lateral thinking, hence they provide a source for new advances at the frontiers of knowledge that could constitute the seed of future development in the industry[30]. Innovations take place in the intersection between various bodies of knowledge. By adding a more complex network, the amount of intersections where innovations can take place is increased.

Nokia's decline has had other implications for innovation ecosystems and it gives a good example of the importance and impact of diversity on innovation ecosystems and economic stability in organizations of various sizes[32]. The decline sped up the Finnish start-up boom as highly skilled and trained former Nokia employees started their own companies, conferences, and organizations, contributing to the thriving entrepreneurial tech sector in Finland[33]. During the decline of traditional industries, the country has been forced to rethink its economy and move away from dependency on a handful of multinational companies to a more diverse mix of start-ups, SMEs, and large corporations[34].

Diversity at an individual level

All interaction relies on trust between individual collaborators, thus collaboration often boils down to the individual level. Diversity amongst people manifests in various ways. A study has shown that organizations with diverse staff achieve better results than homogenously comprised organizations35. As mentioned earlier, innovation often takes place through a process of combining known elements into something new and valuable. The more diverse perspectives that are brought in to the development phase, the greater the variety of potential solutions the organization will end up with. A variety of employee roles and including people with diverse qualifications and expertise are crucial to innovation[36].

The diversity of employees adds value through reflecting the society or marketplace, thus the diversity can help the organization to achieve better results than more homogeneous organizations[35]. Inherent diversity attributes—in other words the traits people are born with, like gender or age—enable the understanding of unmet needs in under-leveraged markets. In a team where at least one member has traits in common with the end user, the entire team understands the user better[37]. Cultural diversity is an advantage as well as a mix of people from a variety of countries and cultures enriches the mix of thoughts. People from a foreign background are able to question assumptions and societal norms. This effect can be seen in action in Silicon Valley for example, where a high percentage of people from a foreign background has shown to have been one of the antecedents of Silicon Valley's success[21]. Companies with employees who have varying diversity traits—inherent and acquired, in other words knowledge gained from experience and qualifications—are most likely to unlock innovation by creating an environment where unexpected ideas are heard. Acquired diversity is especially needed to establish a culture in which all employees are heard and where they feel free to contribute ideas[37].
Finally, what also enhances innovativeness is when participants are new to the industry. With fresh eyes and a fresh mind, individuals are more likely to contribute novel ideas and thinking, and the longer they are in the same industry their likelihood to make a creative contribution diminishes[38]. This justifies the facilitation of different industries collaborating.

Diversity in relationship ties

Not only is diversity between collaborators important, but it is also critical how collaboration ties are formed, what is the nature of interaction and what is appropriate to each context. Despite the fairly confident point of view that diversity aids ecosystem development and enhances the likelihood of innovations, the type of collaboration tie largely defines the successfulness of the collaboration. Recent studies suggest that outcomes are dependent on qualitative differences between the types of ties in these networks[39].

The appropriate measure of productivity for innovation ecosystems is the extent of innovation identified and exploited by a network. Network relationships can potentially be both beneficial and detrimental to the discovery and exploitation of opportunities due to their effect on openness and trust within a network and on the effectiveness of mechanisms for knowledge transfer. In addition to trust and openness (so-called knowledge mobility), it has been argued that outcomes from innovation networks are also closely related to the level of stability[40].

The formality of the collaboration is one of the dimensions of collaboration ties. There are distinctions between formal and informal collaborations such as alliances, knowledge trading, and common participation in associations. Formal collaborations seem to facilitate greater two-way knowledge transfer, which provides potential for both risk and reward. However, as innovations often emerge in unpredictable ways, and informal communication and common practices are essential for tacit knowledge transfer, open forums and informal communication channels are key ingredients in well-functioning innovation networks[41].

QUALITIES OF INTERACTION	IMPACT/BENEFIT
Formality	*Informal:* Exploration; tacit knowledge *Formal:* Execution; two-way codified knowledge transfer Formal in highly competitive landscape *Informal*: trust is essential
Strength of ties	*Strong:* Reduce knowledge transfer problems *Weak:* Bridge disconnected social groups
Number of collaborators	Balanced value creation Reduced negotiation and competition
New vs. old relationships	Diversity of ideas / the unique combination of new ideas

An overview of the types of collaboration ties and their impact or benefit.

Informal collaboration plays a key role in innovation. Through informal collaboration—or in fact, through the absence of formal overtones—individuals are free to develop and collaborate around their common objective, which builds inherent trust. The motivation to operate on the basis of trust is linked to the overall purpose of the network. If the purpose is to establish a performative trading zone, trust can be managed through contractual agreements. Instead, if the purpose is to establish a transformative trading zone, the innovation network needs to establish trust in both the participating parties' ability and the collaboration model[40]. Interactional and informal collaboration mainly support idea generation, while formal constructs like boundary objects are essential for solution implementation in the innovation process.

For innovation ecosystems to flourish there should be formal and informal networks on each level. Formal collaborations are the platforms for explicit knowledge exchange and they facilitate execution. Informal collaborations on the other hand encourage even more sudden and unrelated knowledge exchange, which then feeds into formal collabora-

tion. Informal collaborations can be seen as enablers that, in order to lead to something, need to transform into a formal collaboration. Informal collaborations and interactions can take place in communities of practice and associations.

Another dimension used to describe the relationship type is the strength of the relationship type, which is reflected in invested time, emotional attachment, and the alignment of underlying motivations. Both strong and weak ties are essential, however, they accommodate different styles of interaction. Similar to the formality of the collaboration, strong ties facilitate overcoming knowledge transfer problems but might hinder search and exploration. On the other hand weak ties advance the search process but demand boundary objects or interactional expertise[39]. Weak ties provide non-redundant information and contribute to innovation because they tend to serve as bridges between disconnected social groups. They allow for more experimentation in combining ideas from disparate or disconnected sources and impose fewer demands for social conformity than do strong ties[38].

Capaldo[42] has investigated the tie configuration on each level of the ecosystem and suggests that weak ties on a network level promote innovation, while organizations benefit from strong relationships with their core partners. This pattern indicates that strong ties are also called for in interorganizational collaborations and more explorative work especially takes place between industries and sectors where weak ties create benefits.

Another important factor to consider in the tie configuration is the number of participants in the collaboration. Specifically, bridges across multiple organizational and community boundaries have been found to positively impact innovation outcomes[39]. The transition from two parties connected through a dyadic tie to three parties in the tie is particularly valuable since it alters the impact of self-interest, reduces the bargaining power of individual entities, and facilitates conflict resolution[43].

Finally, the newness of the relationship also plays a role in sparking new ideas within ecosystem members. Research shows that creativity is enhanced on an individual level if more time is spent on networking with a diverse group that includes both acquaintances and strangers as opposed to networking with business colleagues with strong ties. However, there needs to be a constant flow of new acquaintances as after spending time with complete strangers, the ties will soon become stronger and drown out the benefits of non-redundant information[38].

The shift to co-creative practices and culture in order to facilitate complex collaboration

As discussed, diversity through the type of collaborators and relationships has been proven to add value to innovation networks. However, it brings challenges to collaboration by reinforcing the tension between stability and dynamics, reducing trust and making it more complex to transfer, translate, and transform knowledge[40].

With the multilayered nature of innovation ecosystems and the added diversity, co-creative practices facilitate the increased complexities of collaboration and the resulting challenge of knowledge interpretation and transfer. The better the discovery and exploitation of opportunities, the higher the performance of the network. However, the effect can be positive or negative depending on the configuration of openness, trust, and mechanisms of knowledge transfer[40]. Here, we see the benefits of co-creation and culture building. It is an established agreement that there is no magic formula or straightforward way in which innovation ecosystems are developed[29,44], so this calls for deeper collaboration. One has to truly understand the needs of each stakeholder, local conditions, culture, and strategic goals, which results in identifying an appropriate process and actions along the way of such a building process.

Co-creation is defined as an act of collective creativity, in other words it is creativity that is shared by two or more people[45]. It is a joint development activity by multiple actors geared towards a mutually beneficial outcome[46]. The definition has extended from the traditional relationship between a company and its users to involve a diverse mix of actors, for example, management, employees, customers, suppliers, and the public sector.

When implementing co-creation in practice, one must consider multiple principles in order to reach a desired impact. Co-creation does not simply happen, it requires careful planning and implementation in the innovation ecosystem activities. One of the major considerations when implementing co-creative practices is the allocation of time. The more complex a project setup is, with multiple stakeholders, the more barriers to collaboration there are to overcome. Diversity holds great innovation potential but also requires a high level of commitment and patience from network participants[40]. Every sudden change causes disruption and requires extra resources from the actors to resolve it. New procedures can be identified and integrated to the development process, however, this takes time.

Another beneficial approach is to build activities gradually and in an iterative manner, for example by limiting knowledge transfer to small-scale projects, especially in the early stages of ecosystem development[40]. Substantial resources for establishing communication channels, and negotiating and mediating the shared purpose and structure of a system tend to improve trust, both in the collaboration model and between participating actors.

Furthermore, the complexity of the co-creation process, which requires the creation of shared understanding, involves not only the grassroots-level actors but also project management and the organization. The barriers on an individual level are symptoms of the wider challenge on higher levels, which should be dealt with integrally[47]. Paying attention to the project setup and collaborators involved in the process is valuable. This calls for the involvement of actors from multiple levels of the organization and, in an ecosystem context, across organizational boundaries. Knowledge is created on multiple distinct cycles within an organization: on the departmental level, interdepartmental level, and on the project to firm level. Evidence shows that successful organizations intertwine all these cycles of knowledge creation[48]. To enable this collective action, the organizational context and culture needs to support it and co-creation has the power to energize the whole organization[46]. A fundamental shift in the mindset of the organization and realization need to happen as interactions among individuals

everywhere in the system are the new locus of value creation.

One way of facilitating knowledge transfer across a complex web of people, companies, and the public sector is to include knowledge broker roles, which are non-traditional roles within organizations. Brokers have the ability to stimulate the transfer of non-codified knowledge, which is especially needed in situations with a high degree of openness[40]. In the Design Factory Global Network, there is an established role of a coach within a university and one of her or his main tasks is knowledge harvesting and dissemination. Another example has taken place at Teesside University with a slightly different approach. A lack of a clear contact point was identified to be a barrier in establishing relations and engaging with other business in one of their partnership initiatives, Digital City Innovation (DCI). They established a Community Engagement Coordinator to ensure a single point of contact who works with each business to improve their efficiency. This role has been complemented by workshops that allow further networking opportunities and introduce new members to the community[29].

Finally, another method to implement co-creation in practice is to use tools and methods in the creation process that are specifically tailored to the ecosystem context. A Value Framework has been developed as a tool to support the process of creating shared value for multiple stakeholders with meaningful innovations, which provide value on multiple levels simultaneously to the user, organizations, and ecosystems and provide larger societal value. The benefit of this Value Framework is two-fold: it enriches the value proposition with the help of different perspectives and supports the co-creation process by providing a common language with which to discuss different perspectives[49].

Future considerations and implications

This chapter set out to create a holistic understanding of the importance of diversity in thriving innovation ecosystems on multiple layers and of the co-creative mindset as a key driver in facilitating the collaboration. As discussed, diversity is a vital nutrient in sustaining innovation as it results in the constant cross-pollination of ideas, knowledge, and technology between actors in the system. The more diverse the mix of actors is in the ecosystem—on multiple levels—the more fruitful the interaction and the innovative outcomes. However, diversity also presents alignment challenges and actors have differing goals, knowledge sets, and behavior. With co-creative principles, deep collaboration with input and commitment from participating stakeholders can unveil or harness opportunities that are otherwise unreachable through what we refer to as traditional, transactional collaboration.

A co-creative innovation ecosystem takes time to develop and is a longer-term investment. There are multiple approaches and starting points to facilitate the development. However the fundamental, common element is the change in the mindset towards a culture of mutual benefit. Embracing diversity is not for short-term wins but should be treated as a long-term investment for better wellbeing.

As innovation ecosystems become more complicated, the importance of a co-creation mindset is increased. We have observed an emerging shift in innovation ecosystem paradigms towards complexity: From a triple helix system—public sector, universities / research organizations, and the private sector—towards a quadruple or even quintuple helix system, involving citizens and the media in knowledge dissemination[50]. By and large, it means that even people who are not directly involved or impacted by the development activities should be considered, and be better informed and engaged with activities. We, and other researchers, organizations, and governments, can then ask the question: How can we harness the knowledge and expertise of engaged citizens and what role do they play in making the ecosystems smarter[14]?

We expect the variety of other actors to increase along the ecosystem's evolution and the roles of the major stakeholders—the public sector, universities, and industry—will continue to shift. The public sector may increasingly seek to enable and facilitate larger networks of relationships and streamline the regulatory environment in order to encourage collaboration. Another important role as the custodian of society is to assist in managing risk, overseeing that value is distributed across stakeholders and mediated, and mitigating the competitive landscape to make sure that activities are built upon, rather than obstructing others[29]. Also, the role and involvement of the public sector depends on the ecosystem's evolution phase. Especially during early stage of the development of an ecosystem, it may need to provide more support and become an active driver of change.

Similarly, we see that the role of the private sector—industry—continues to evolve beyond their organizational boundaries and presents the opportunity to become an integral part of society. Users, clients, and citizens are active co-creators, thus blurring the boundaries between non-profit and for-profit businesses and supporting business models that span traditional boundaries. Indeed, a collaborative and shareable environment, a fair business spirit, altruism, partnerships, good integration with civil society, and diversity of culture are likely to enhance ecosystem development[44]. In addition, we believe that industry will and should be more involved as part of educational delivery, with universities co-creating next-generation employees.

Finally, universities' contribution to ecosystems is increasingly oriented towards objectively creating and interpreting knowledge and capacity building. This is in line with Markkula and Kune[14], who emphasize the strengthening role that academia has. Universities bring societal value as they hold important resources, research, education, and innovation activities that are beneficial to the educator role. Traditionally, universities have been seen as educators of the future workforce and the creators of new knowledge, but through co-creative partnerships with businesses the role shifts to capacity building for the whole innovation ecosystem. This is in line with the trend of life-long learning that extends beyond formal qualifications. Another trend we see, which is in line with the growing importance of open innovation, is the dissemination of knowledge to a wider audience. It will help entire regions to develop the ecosystem in order to produce solutions beneficial to society.

THE WAY FORWARD

The way forward

The middle-aged workers of today, who have already spent two decades or so in the workforce, will still be working in 2030. On the other hand, those still studying will still be in the workforce in 2060. What skills will they need? What do they need to learn? In the ever increasing pace of change in our society, it is hard to picture how the world and its technology, jobs, economy and society will look like in 2030, let alone 2060. Exponential change can be mind-boggling: whereas 30 normal steps would take you more or less 30 meters further, if you double each step compared to the previous one, you'd walk to the moon and back before setting your foot down on the 30th step. There is no U-turn in this development. We are embracing complexity.

However, traditional monodisciplinary approaches will not suffice in tackling challenges or developing new meaningful things for this future. Megatrends, such as mobility, e-commerce, and sharing economies, and global challenges such as climate change, inequality, and legislation struggling to keep up with our changing society, pose not only technical but ethical dilemmas. For example, technology becomes entwined with moral judgement, with data-driven decision making algorithms potentially codifying biases in their processing, or driverless vehicles making judgements calls on who or what to prioritize in an imminent collision. These challenges and issues become interconnected and entwined, requiring a holistic view to treat them effectively. They require more than just working harder. Yes, there are millions of people who are ready to, and do work harder than is good by any human standards. But as in sports, if you only rely on working harder and harder, your career will not last very long. We need a better way of creating our future.

Nine years ago, when the very first Design Factory opened its doors, we had set out on a mission to change our industry, starting with our own organization. In our case, this meant trying to transform learning in higher education through introducing a new way of collaborating and experimenting along with a platform to support doing so. Aalto Design Factory was born, and with it, the approach we have come to call passion-based co-creation. Nearly a decade has passed, but have we been the change agents we set out to be? Does this stuff actually work?

Yes and no. Higher education (like most industries) is operating in a changing landscape marked by global competition between countries, companies, and institutes, with the entire meaning and role of higher education changing. Massive changes are being made without always having a clear understanding of the endgame of it all. When you have a clear guiding star shining above you, you can keep your course, keeping your eyes fixed on the horizon. However, when the fog rolls in to block your view - or you have a number of beacons enticing you in different directions - you're better served by experimenting your way forwards, making a number of small commitments and keeping your eyes open for feedback, correcting your course as you learn along the way. Experimentation seems the wiser path to carve into our future.

Our network has grown into Design Factories in twenty-three universities or institutes that want to create a better way to develop and learn in this new topography. The passion-based co-creation platforms are needed not only for working hard, but also for finding the energy that makes you work (hard) for a lifetime, while actually living your Life simultaneously. Some may call this energy "meaning", "joy", "belonging", or "fun", and the place a "skunkworks", "garage" or "laboratory". Certainly, co-creating passionately will at times cause stress, pressure, disappointments, and conflicts – but it simultaneously helps to better cope with all of those curveballs and low-points along the way through building community, trust, friendships, respect, visibility, and celebrating successes. In short, creating fruitful conditions for learning.

Clearly there has been a demand for passion-based co-creation. At Aalto, the utilization rates of Design Factory are high and interest is ever growing. Rather low-cost reshaping of a building from 1958 has turned old, unused spaces into something exciting, something that is more than just a building. The machines in our prototyping facilities are used so much that they cannot get outdated, as they need to be replaced due to wear and tear far before becoming obsolete. We have held on tightly to our focus on users; constantly experimenting based on user needs, and using feedback to improve ourselves. We still want to always say "yes", rather than defaulting to an easy conservative "no". Like with the assumption of innocence in the justice system, new ideas should be assumed valuable until otherwise proven, rather than having the heavy burden of proof laid upon them before they've even stretched their feet.

However, after nine years of Aalto Design Factory, we are hardly new anymore. We've collected useful ways of working and thinking over the years, but also some detrimental ballast. Even a history of success can be a burden, energy tapering off as we get comfortable and experimenting starts to take a turn for maintenance. It would be easy to lose sight of the nuances that are routine and everyday for us, but exciting for visiting outsiders, or important for our students. This is where passion-based co-creation becomes a lifeline for change agents. *Stir, empower, embrace, connect* and *act* works as our recipe for both keeping ourselves energized and engaging new people to our efforts. As we emphasize employing students of our institution, during these nine years more than 200 employees have worked to improve the Aalto Design Factory platform (with the staff never being more than 25 strong), bringing in a steady supply of new perspectives. Likewise, the newer members to our global network create new learnings that challenge our existing ways in a positive manner.

During this time, we've also borne witness to a number of cautionary attempts for change. A typical recipe for failed development goes as follows

1. Use external consultants as developers rather than facilitators, communicating that you do not trust your organization's own capabilities and capacities.

2. Ask everyone what they want, resulting in - if anything - a huge list of conflicting "needs" and incremental wishes for faster horses rather than cars. Safely and securely ensuring that nothing is lost... and nothing is changed.

3. Have a completely undefined schedule, budget and pool of resources, making it impossible to get going while simultaneously feeding into destructive rumors.

4. In the end, designing and implementing a fixed result that cannot be changed by the smallest detail when finally put to the use, skipping the experimenting and going straight to the outdated legacy of yesterday.

We suggest you cook something else instead.

Passion-based co-creation is another dish altogether. So many people have given feedback about the community at the Design Factories. Many of them share the feeling that whatever may come, they will not face it alone, and they will learn along the way. The price they pay for this is that they must make themselves easy to help. They cannot act according to the typical standards of anonymity, responsibility for nothing (or only for one's own business), sticking to detailed instructions, or hiding both mistakes and emotions. They must make themselves visible, take timing into account, be proactive – and maybe something close to "aus Liebe zur Kunst". The future is not born by itself in a vacuum, rather it is co-created through the actions of us all. While much remains to be done and we keep on iterating and experimenting with practices, facilities and methods, passion-based co-creation offers a sound foundation that works both in theory and in practice for going forwards. It can help you build curiosity, courage, communality and caring, offering a fruitful ground for development efforts and learning.

The best way to ensure a future of our liking is to do something about it.

ABOUT THE AUTHORS

EDITORS

Kalevi Ekman (Aalto Design Factory) is the father, director and founder of Design Factory. He's a professor in machine design in the Aalto University School of Engineering, and teaches one of longest standing and largest multidisciplinary, multicultural courses in the university. He has received multiple awards for his groundbreaking work in product design and at the Design Factory, including the Jose Vasconcelos World Award of Education from the World Cultural Council.

Tua Björklund (Aalto Design Factory) is one of the co-founders of Design Factory. She conducts and leads research, teaches product design, and facilitates pedagogical development at ADF. Tua has a DSc degree in industrial management and a MA degree in cognitive science, looking at co-creation from a social and psychological perspective. She is particularly interested in how to support translating ideas into action with the help of prototyping and working practices in knowledge work.

Senni Kirjavainen (Aalto Design Factory) worked in developing the very first iteration of the facilities of the Design Factor,y and has since joined building the scientific foundation of the Factory. She's been on board since the Factory's predecessor, Future Lab of Product Design. Senni has an MA degree in industrial and strategic design and is currently working on her PhD in product development, exploring design thinking and how to best support creative work.

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Pia Hannukainen took part in giving birth to the Design Studio back in 2004, the first idea of something that later became the Aalto Design Factory. During her years at as a researcher in Aalto University, she conducted research and taught strategic user involvement in product and service development, specializing in user innovation and lead users. Pia recently changed positions to become a senior research manager in the financial sector.

Lotta Hassi (ESADE Business School) has 10 years of experience working in the fields of innovation and design, as an entrepreneur, consultant, researcher and lecturer. She is a lecturer at ESADE Business School, the director of programs such as the Innovation Lab and Design Thinking for Business Innovation, and will act as the director of the newest addition to the Design Factory network, the Fusion Point in Barcelona. Drawing from an MSc degree in economics, her research focuses on experimentation in innovation, and she recently published a guidebook to experimentation, directed to innovation managers.

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Matti Hämäläinen spent four years as the Operative Director of Tongji Design Factory in Shanghai, China. During this time he was localizing the Design Factory concept to fit the Chinese context, while also developing its operations and practices. In addition, he has experience from the Aalto Design Factory, having worked as a research manager at Aalto University and Helsinki University of Technology for years. His research focuses on co-creation and knowledge management in product design process. Currently Matti is a Free Agent and consultant operating in Finland.

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Pauliina Mattila (Design Factory Melbourne) graduated with studies completed at the Aalto Design Factory, and has been the coach at Design Factory Melbourne for the past 4 years. Her role at DFM includes teaching and coaching in local and international programs, research and strategy development. Pauliina holds a MSc degree in International Design Business Management and her research interests include innovation ecosystems, combining qualitative and quantitative research methods, and coaching in higher education.

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Stefania Passera (Aalto University School of Science) has worked at MIND Research Group, located at Aalto Design Factory, since 2009. She was in charge of the Internship Innovation Project, a multidisciplinary, hands-on innovation course jointly provided by Aalto University and ESADE Business School. Stefania holds a DSc degree in industrial management and an MA degree in graphic design. Her research focuses on how visual communication can be employed to make contracts user-friendlier, and she's a freelance designer and consultant specialized in service and information design.

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Carl Turner (Design Factory Melbourne) was Industry Innovation Projects Coordinator and Facilitator in Design Factory Melbourne (DFM) from 2014-2016. Carl is investigating an industry-engaged PhD, at the intersection of service design, creativity and digital technologies. His professional industry background includes managing offshore petroleum drilling operations, and strategic service design for the financial services industry.

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Tuuli Utriainen (CERN IdeaSquare) is facilitating a human centred approach for innovation at CERN, where she creates novel forms of radical collaboration. She has been setting up a variety of experiments on collaboration between different stakeholders, including the Challenge Based Innovation program. Currently Tuuli is conducting research on futuristic ways of defining and solving problems at a global scale.

THE LOOKS

George Atanassov (Aalto Design Factory) is the photographer-in-residence of Aalto Design Factory, with most of the photos in this book and Design Factory communications in general coming through his lens. He is also the IT expert and website master at Aalto Design Factory, merging technology, design and art in one person. George has worked in Aalto University before it even became Aalto, starting as a research assistant back in the days of the Helsinki University of Technology.

Joel Meneses Ibarra (Aalto Design Factory) is behind the layout and most of the graphics not only in this book, but much of the visual cues of Aalto Design Factory and the publications of the Design Factory Global Network. Since joining the Design Factory in 2014, he has brought not only a great artistic touch but a deep passion to enhancing understanding by capturing the otherwise tacit subtleties of the Factory.

Photograph credits: George Atanassov, the authors and the international DF community unless otherwise stated. Graphics by Joel Meneses Ibarra excluding those indicated otherwise along with the following icons from the Noun Project: Luis Prado, Matthew Davis, No More Heroes, Maxim Kulikov, Martyn Jasinski, Oliviu Stoian, Samy Menai, Ralf Schmitzer.

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THE BASICS
PASSION-BASED CO-CREATION

Setting the stage: From lonely riders to co-creators

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Towards passion-based co-creation

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All you need is love, design, business, engineering, and...

As our world is getting evermore interconnected and entwined across professional, organizational and national boundaries, challenges rarely fall neatly into the realm of single functions, departments or disciplines any more. While it is uncertain what the world will look like in a few decades, and many of the needed skills and approaches are unknown, we do know we need a way of creating the future together. Counting on a few heroic innovation champions will not suffice in transforming our organizations.

Passion-based co-creation describes the approach to tackling these issues that has led to the creation of Aalto Design Factory and the Global Design Factory Network of 20 co-creation platforms around the globe. Our approach, in a nutshell, is a way of creating something new together, sprinkled with a hefty dose of intrinsic motivation. Sound too hype-y? Worry not, we aren't preaching the adoption of yet another "perfect' tool, licensed process, or turnkey solution. Rather, we want to share some principles we have found effective, offer a look into the scientific backbone of our approach, and provide tangible examples on how to bring the mindset and ways of working into your organization. Mix, match, and adapt these elements to create your own personalized stack of building blocks for passion-based co-creation in your unique context.